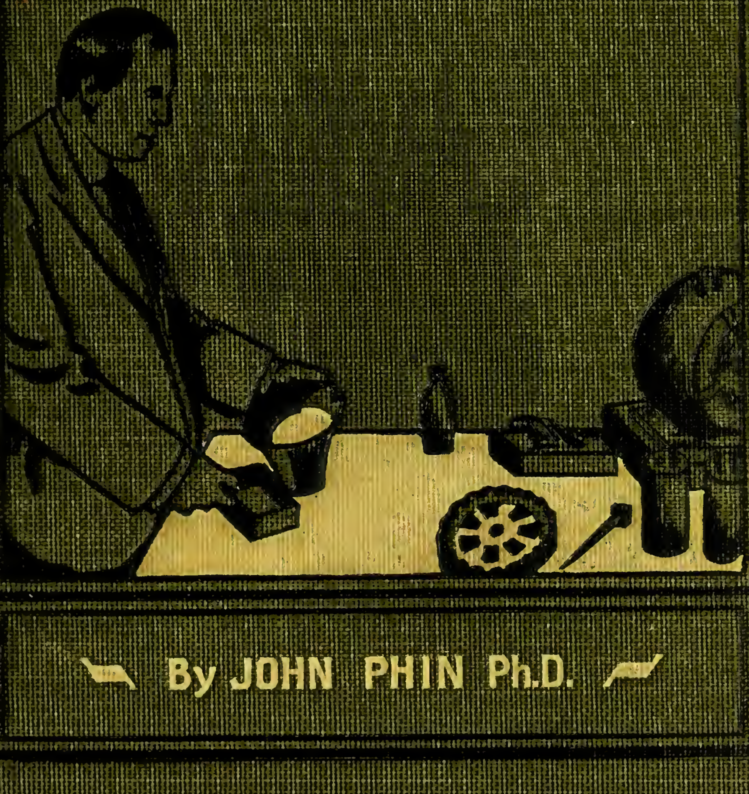
INDUSTRIAL RECIPES



By JOHN PHIN Ph.D.

INDUSTRIAL RECIPES

A COLLECTION OF USEFUL, RELIABLE, PRACTICAL
RECIPES, RULES, PROCESSES, METHODS
WRINKLES AND PRACTICAL HINTS

FORMING A RELIABLE

WORKSHOP COMPANION

FOR ALL ENGAGED IN THE VARIOUS INDUSTRIAL
ARTS AND TRADES

***By* JOHN PHIN, Ph.D.**

Author of "SUCCESS WITH RECIPES," "TRADE SECRETS"
"CEMENTS AND GLUES," "HOW TO USE THE MICROSCOPE," ETC.

THIRD EDITION—GREATLY ENLARGED

NEW YORK
INDUSTRIAL BOOK COMPANY
1913

INDUSTRIAL RECIPES

PREFACE

The following pages have been prepared with very great care, the chief aim being to give none but recipes which will not disappoint those who attempt to use them. Several of the recipes here given are original, the formulæ having been worked out or improved by the author after much labor and experiment. In searching for really good formulæ, we have been astonished at the errors which have crept into many of our standard books of recipes. For example, in one case the two separate operations of a well-known process for staining wood are given as distinct, and, of course useless recipes! In a seemingly favorite recipe for a washing fluid, the reader is directed to add vinegar to the ammonia employed, thus entirely neutralizing it. In the same way we find a recipe for transferring printed engravings to wood, in which the alkali (potash) is neutralized with vitriol! We suppose that in the last case, the author of this recipe thought that *two* strong liquids must be better than one, forgetting or not knowing the fact that one destroys the effect of the other. A very slight knowledge of technological science would have enabled the compilers of these books to avoid such blunders. In addition to these defects, however, most of our large books of recipes contain so much that is entirely useless to the practical man, and so many mere repetitions of the same recipe in different language and terms, that their cost is greatly increased while their value instead of being enhanced, is actually lessened. We have, therefore, endeavored to combine in the following pages all that is really of practical value to the professional or amateur mechanic, and at the same time by giving only one or two

of the best recipes under each head, we have not only simplified the work, but we have brought it to such a size and price that every one can afford to buy it.

The subjects treated of in this work are arranged alphabetically, so as to avoid the necessity of constant reference to the index. A few words in regard to the method pursued in arranging the matter may, however, not be out of place. As we believe that the greatest advantage will be derived from bringing together at one place not only the special instructions in regard to particular processes, but the general information relating to the materials, etc., employed, we have in most cases collected all such matter together under one head. Thus, under the head of "Steel" will be found not only a description of the different kinds of steel, but directions for forging, tempering, etc., but as most persons who consult this book would most likely look under the head "Tempering" for information on that particular subject, we have entered the word "Tempering" and under it give a cross-reference to "Steel." This is the reason why we have introduced so many cross references, every one of which was put in *after* the book was written, so that the reader will not be disappointed when he turns to the heading to which he is directed. Many of our readers, doubtless, know that in too many volumes of this kind, cross references are inserted merely for the purpose of swelling the apparent amount of information contained in the volume, and very often when the reader turns to the heading to which he is directed, he finds that the subject which he is looking for has been omitted. In the present case, the utmost care has been taken to prevent disappointment of every kind, and whenever information is promised we have endeavored to give it fully, accurately, and in the simplest possible language.

J. P.

PREFACE TO REVISED EDITION

PREFACE.

The extraordinary favor which has been accorded to the first part of THE WORKSHOP COMPANION—over twenty-five thousand copies having been sold without any special effort—has induced the author to prepare a second part, containing matter for which he has received numerous inquiries from readers of the first part.

In doing this he has received aid from some of the best practical writers in the country, and feels assured that the matter now given will prove as thorough, as reliable, and as clearly expressed as that which preceded it. So that the work now forms a compact and convenient cyclopedia of information for everyday life.

In collecting the information here given great care has been taken to offer nothing but what is thoroughly reliable. It is a fact well known to all intelligent technologists that a very large proportion of our best recipes are to be found in volumes published many years ago, whence they have been copied and recopied by different compilers. And it is also a fact, though one less generally known, that the sources of new information upon which these same compilers depend are just the ones in which the most recent knowledge is not to be found. As a general rule the authors or compilers of our modern collections of recipes have gone to the "Question and Answer" columns of the popular scientific and technical journals, ignorant of the fact that even when these questions

are *bona fide*, the answers are usually taken from some one of the old recipe-books. Indeed it often happens that even when the questions are the genuine inquirings of some seeker after special knowledge, and the answers are given by fellow-subscribers, the latter obtain their replies from commonplace and easily accessible books of recipes, and send them to the journal more for the sake of seeing themselves in print than from any other motive. Now and then we find a reply which is based upon the actual and intelligent experience of the correspondent, and such replies are beyond all value. But unfortunately such information is as rare as it is valuable.

The difficulty of attaining simplicity and trustworthiness in a work of this kind is best illustrated by the statement of the compiler of one of the most extensive collections of recipes published in this country. He tells us that he set out with the intention of carefully sifting the vast accumulation at his command, and preparing a collection of popular and domestic recipes which should contain only those whose practical utility had been established, either by actual trial or by the guarantee of undoubted authorities. But he further tells us that as the work progressed this was found to be impracticable; and those who are competent to examine his book critically will find that he has ended by publishing everything — good, bad, and indifferent, — the same recipe frequently appearing in a slightly different form half a dozen times!

Several of the articles in this volume, although original with the editor, have appeared in the mechanical journals of the day, and have been thence copied into other publications, and generally without credit. This is notably the case with

the articles Cements, Soldering and Brazing, Weight of Patterns for Castings, Nails, Glue, and some others, which have been copied not only into contemporary journals but into numerous books of recipes and works on mechanics. These articles were written for the first volume of *The Manufacturer and Builder*, of which the author of this volume was editor-in-chief, and for *The Technologist*. As for The Workshop Companion itself, it has simply served as a mine from which editors and contributors might draw short and valuable articles when their pages were otherwise destitute of sound practical matter. In fact, one rather pretentious English periodical has published nearly the whole of it, piece by piece, and without the least credit!

All this, however, is offered in a spirit of explanation,—not of petulant complaint.

The size of the present work has been greatly reduced and its actual intrinsic value proportionately increased, by adhering strictly to the dictionary form. In works which are divided into so-called "Departments," the same information is given over and over again, in almost the same words, under the different heads. Thus in one of the $5 books now in the market we find the same recipe repeated at *five* different places! The absurdity of having "Departments" for Blacksmiths, Gunsmiths, Machinists, Painters, Cabinetmakers, etc., is seen at once when we ask the compilers to point out the difference between the process for casehardening as used by blacksmiths and that employed by gunsmiths; or the varnishing of wood as applied by painters and by cabinetmakers. Tell us how to caseharden, and place the information under the letter C; or, if you choose, under the word "Iron," with

a cross-reference from "Casehearden," and then blacksmiths, cutlers, engineers, gunsmiths, machinists, amateurs, and every one else can use it, and no space is wasted by giving the same information in half a dozen different places to as many different artisans. And by a liberal use of cross-references, as is done in this work, no difficulty need be met in finding any particular item of information.

Before closing this preface there is one point concerning which we can not refrain from expressing a hope,—and that is in regard to the aid which amateurs and young people will derive from the volume. There are a hundred little things which may be done in every household to an advantage greater than that arising from any mere saving of money or actual convenience. Boys who occupy themselves in the evenings binding books and decorating glass will not be likely to long for the saloon and the billiard-table; and girls who have some pleasant occupation will not break their hearts because they are not taken every week to the theater or the concert. As a protection to young people there is nothing like giving them something to do that will interest them. But in order that they may be interested they must be able to do well whatever they undertake to do at all; and it is hoped that this book will on many occasions aid them in securing the necessary success.

JOHN PHIN.

INDUSTRIAL RECIPES

Abyssinian Gold.

This compound was so called because it was brought out in England during the recent war with Abyssinia. It consists of copper, 90·74; zinc, 8·33. This alloy, if of good materials and not heated too highly, has a fine yellow color, resembling gold, and does not tarnish easily.

Accidents.

As those who are engaged in mechanical pursuits are peculiarly liable to accidents, we have introduced under the proper heads (Burns, Eye, Fires, Poisons) such brief suggestions as we thought might prove valuable to our readers. For more minute directions in regard to drowning, severe cuts, gunshot wounds, sprains, dislocations, etc., we must refer the reader to some one of the numerous treatises which have been published on this subject . The following general rules will be found useful in all cases :

General Rules. 1. The first thing to be done in all cases is to send for a physician. While the messenger is gone, endeavor to make the patient as comfortable as possible, and save him from all exertion, remembering that he needs all his strength. 2. If there be any severe bleeding, stanch the blood by means of compresses applied to the veins or arteries, as the case may be. 3. If the patient be insensible, place him on the ground or floor, lying rather over to or directly on one side, and with the head slightly raised. Remove necktie, collar, etc., and unbutton or split open any clothing pressing

tightly upon the neck, chest, or abdomen. 4. As a restorative, sprinkle the face with cold water, and then wipe it dry. Some cold water may be given to drink, if the power of swallowing be present, but do not pour stimulants down the throat, unless there be clear evidence that they are needed. 5. Do not move the patient, unless to get him to a place of shelter, and when he has reached it, make him lie down and seek quiet. 6. Allow no useless talking, either to the patient, or in his presence. 7. Cause the bystanders to move back and leave a clear space of at least ten feet in every direction around the patient. One of the best restoratives is fresh air, and a crowd cuts this off completely.

Stimulants should be avoided, except in cases urgently demanding their administration, but they are agents of much value in the treatment of that condition of collapse and faintness which very commonly occurs after some physical injuries. The symptoms may be briefly sketched: The face is pale and bedewed with cold or clammy perspiration; the surface of the body generally cold; the pulse flickering, perhaps hardly perceptible; the patient complains of the feeling of faintness, and may have nausea, or even actual sickness; the breathing is sighing and irregular, and for a time there may be actual insensibility. Now under such conditions there can be no question as to the propriety of inducing reaction by the administration of stimulants.

Coffee given hot and strong, and in small quantities, is a safe and useful remedy.

Spirituous liquors are more potent in their effects, and the good effect is produced more speedily. Brandy is the best spirit, given in more or less diluted form; failing this, rum or wine may be given. If the spirits can be obtained only from some low grog shop, then whiskey is to be preferred to brandy or wine, as being less liable to adulteration. In administering these articles the best practical rule is to give a small quantity at first and watch the effect; if the surface becomes warmer, the breathing deeper and more regular, and the pulse at the wrist more perceptible, then there can be no question as to the advantage of giving even a little more; but if these signs of improvement are wanting—if there be increase of insensibility, and deepening of color about the face, with access of heat of skin—withhold alcohol entirely; it will but add to the mischief.

Alabaster.

This material is so common and yields such beautiful results when worked, that a few hints in regard to working and mending it may not be out of place.

There are two distinct chemical compounds to which the name of alabaster has been applied, the most common being the sulphate of lime, while that known as *oriental alabaster* is a stalagmitic carbonate of lime, compact or fibrous, generally white, but of all colors from white to brown, and sometimes veined with colored zones; it is of the same hardness as marble, is used for similar purposes, and is wrought by the same means.

Of the common alabaster (sulphate of lime) there are several varieties. The finest white alabaster is obtained from Italy, but very excellent specimens are found near Derby in England. (They must not, however, be confounded with Derbyshire or fluor spar which is a calcic fluoride.) The variegated kinds are turned into pillars, vases and various ornamental forms, the tools used being very simple, namely, points for roughing out, flat chisels for smoothing, and one or two common firmer chisels, ground convex and concave for curved lines. After being brought to the proper shape, the work is polished as follows: Take a piece of very fine, soft sandstone, and apply it with water to the work while in quick motion, moving the stone all over until there is worked up a body of mud. Then take a clean rag and work this sludge well on the alabaster, after which wash the work clean. Apply a rag charged with putty powder and water until there is a gloss upon the work, after which apply another rag charged with a mixture of putty powder, soap and water for a short time, and wipe the alabaster dry. If carefully performed the polish will be very beautiful.

Alabaster readily absorbs grease and dirt, and as it is difficult to clean, great care should be taken to prevent it from coming in contact with anything that will stain it. Dust, etc., may be removed by means of pure water to which a little ammonia has been added. Grease and similar stains may be removed by allowing the alabaster to lie for some time in contact with a paste of powdered chalk moistened with a solution of potash or soda. Soap should never be used for cleaning alabaster, as it leaves a greasy stain. Unlike marble,

alabaster is not affected by common acids, and therefore they may be used for extracting stains of common ink, etc.

The proper cement for uniting pieces of alabaster is plaster of paris made into a cream with water as for making ordinary casts. The surfaces to be joined must be moistened with water.

Alcohol.

This familiar liquid requires no description, but it may not be out of place to caution our readers that failure in the making of varnishes, etc., very often arises from the use of alcohol which by standing has lost its strength. Ordinary alcohol is a mixture of alcohol and water, and as the alcohol evaporates more readily than the water, when the mixture is allowed to stand for any length of time it becomes reduced in strength, that is to say the proportion of alcohol becomes less and that of the water more.

Alloys.

In making alloys, especially where the component metals vary greatly in fusibility and volatility, the following rules must be observed :

1. Melt the least fusible, oxidable and volatile first, and then add the others heated to their point of fusion or near it. Thus if we desire to make an alloy of exactly one part copper and three zinc, it will be impossible to do so by putting these proportions of the metals in a crucible and exposing the whole to heat. Much of the zinc would fly off in vapor before the copper was melted. First melt the copper and add the zinc which has been melted in another crucible. The zinc should be in excess, as some of it will be lost anyway.

2. Some alloys, as copper and zinc, copper and arsenic, may be formed by exposing heated plates of the least fusible metal to the vapor of the other. In making brass in the large way, thin plates of copper are dissolved as it were in melted zinc until the proper proportions have been obtained.

3. The surface of all oxidable metals should be covered with some protecting agent, as tallow for very fusible ones ; resin for lead and tin ; charcoal for zinc, copper, etc.

4. Stir the metal before casting, and, if possible, when casting, with a whitewood stick ; this is much better for the purpose than an iron rod.

5. If possible, add a small portion of old alloy to the new one. If the alloy is required to make sharp castings, and strength is not a very great object, the proportion of old alloy to the new should be increased. In all cases a new or thoroughly well cleaned crucible should be used.

Albata.—Known also as "British plate," "electrum," etc. It is a favorite material for making articles that are to be electrotyped. The best proportions of the ingredients are copper, 20 ; nickel, 4 ; zinc, 16.

Alloy for filling holes in Iron.—Lead, 9 ; antimony, 2 ; bismuth, 1. This alloy is sometimes called "mock iron ;" it expands in cooling, so that when a hole is filled with the melted alloy, the plug is not loose when it is cold.

Alloy for Uniting Iron, Steel and Brass.—The following composition may be cast on steel or iron, and will adhere firmly thereto. Its rate of expansion is nearer that of iron and steel than any similar compound. When cast around iron or steel therefore, it closes firmly around them and does not become loose by alternate expansion and contraction. It consists of tin, 3 ; copper, 39½ ; zinc, 7½. Since the last metal is partly converted into vapor at a high temperature, the above proportion may be slightly increased.

Aluminium Bronze.—Copper, 90 ; aluminium, 10. Resembles gold in color, and is very strong and durable.

Aluminium Silver.—Copper, 70 ; nickel, 23 ; aluminium, 7. Has a beautiful color and takes a high polish.

Amalgam for Silvering the insides of Globes, etc.—1. Lead, 2 oz. ; tin, 2 oz. ; bismuth, 2 oz. ; mercury, 4 oz. Melt the first three and add the mercury. The glass being well cleaned, is carefully warmed and the melted amalgam is poured in and the vessel turned round until all parts are coated. At a certain temperature this amalgam adheres readily to glass.

2. Bismuth, 8 ; lead, 5 ; tin, 3 ; mercury, 8. Use as directed for No. 1.

Amalgam for Electrical Machines.—1. Tin, 1 oz. ; zinc, 1 oz. ; mercury, 2 oz.

2. *Bœttger's Amalgam.*—Zinc, 2 oz. ; mercury, 1 oz. At a certain temperature (easily found by experiment) it powders readily, and should be kept in a tightly corked bottle. Said to be very good.

Cock Metal.—Copper, 10 ; lead, 4. Used for casting cocks.

Copper Amalgam.—Dissolve 3 oz. sulphate of copper in

water and add 1 oz. sulphuric acid. Hang clean iron scraps in the solution until the copper has fallen down in fine powder. Wash this powder, moisten it with a solution of protonitrate of mercury, and then to each ounce of the powder add 2½ oz. mercury, and rub up in a mortar. When thoroughly mixed, wash well with hot water. This amalgam is easily moulded, adheres readily to glass, porcelain and some metals, takes a fine polish, and in 10 to 12 hours it becomes so hard that it will scratch gold or tin. When heated it softens, and may be easily moulded. As it does not contract on cooling, it has been used by dentists for filling teeth, and it might be used to good advantage for inlaying lines in dark wood.

Protonitrate of mercury is easily made by dissolving mercury in nitric acid.

Babbitt's Anti-Attrition Metal for lining Boxes.—First melt four pounds of copper, and, when melted, add, by degrees, twelve pounds best quality Banca tin; then add eight pounds regulus of antimony, and then twelve pounds more of tin, while the composition is in a melted state. After the copper is melted and four or five pounds of tin have been added, the heat should be lowered to a dull red heat, in order to prevent oxidation; then add the remainder of the metal. In melting the composition it is better to keep a small quantity of powdered charcoal in the pot, on the surface of the metal.

The above composition is made in the first place, and is called hardening; for lining work take one pound of the hardening and melt with two pounds Banca tin, which produces the very best lining metal. So that the proportions for lining metal are four pounds copper, eight regulus of antimony and ninety-six pounds tin.

The object in first preparing the hardening is economy, for when the whole is melted together there is a great waste of metal, as the hardening is melted at a much less degree of heat than the copper and antimony separately.

Belgian Antifriction Metals.—For work exposed to great heat: Copper, 17; zinc, 1; tin, 0·5; lead, 0·25.

For parts liable to much concussion: Copper, 20; zinc, 6; tin, 1.

For parts exposed to much friction: Copper, 20; tin, 4; antimony, 0·5; lead, 0·25.

Cheap Antifriction Metal.—Equal parts of zinc and lead

melted together, and well stirred at the time of pouring into the box or bearing.

Fusible Metals.—These are chiefly used as a means of amusement, spoons formed of them melting readily in hot tea or coffee. They have also been used to make plugs for steam boilers, the intention being that they should melt and allow the steam to escape when the pressure became too great. No. 4 has been used for making casts of coins and medals, and the beautiful French cliché moulds were made of it.

1. Newton's fusible metal: Bismuth, 8; lead, 5; tin, 3. Melts with the heat of boiling water.

2. Onion's metal: Lead, 3; tin, 2; bismuth, 5. Melts at 197 degrees, Fahrenheit.

3. Wood's fusible metal: Bismuth, 15; lead, 8; tin, 4; cadmium, 3. Melts between 150 and 160 deg. Fahr.

4. Cliché metal: Bismuth, 8; tin, 4; lead, 5; antimony, 1. The metals should be repeatedly melted together and poured into drops or granulated, until they are well mixed.

Pewter.—Tin, 4; lead 1. Old articles of pewter form therefore, a very fine metal for solder.

Queen's Metal.—Tin, 100; antimony, 8; copper, 4; bismuth, 1. Resembles silver in appearance.

Speculum Metal.—Copper, 32; tin, 15; arsenic, 2. First melt the copper, and then add the tin which should have been melted in a separate crucible. Mix thoroughly and add the arsenic.

Type Metal.—Lead, 44; antimony 8; tin, 1.

Amber.

Amber is principally obtained from the shores of the Baltic, but it is also found in other parts of Europe. The most esteemed is the opaque variety, resembling the color of a lemon, and sometimes called fat amber; the transparent pieces are very brittle and vitreous. The German pipe makers, by whom it is principally used, employ thin scraping tools, and they burn a small lamp or place a little pan of burning charcoal beneath the amber to warm it slightly whilst it runs in the lathe. This prevents it from chipping out, but if it is too highly heated by friction it is apt to fly to pieces.

The finer specimens of amber, which are sometimes formed into gems and ornaments, are ground on lead plates made to revolve in the lathe, any of the usual abrasive substances

(sand or emery) being used. The facets are then finished by means of a whetstone, and polished with chalk mixed with water or vegetable oil. The final finish is given by means of flannel. During the polishing process the amber becomes very warm and highly electric, and if this heating goes too far it will fly in pieces. The workmen, therefore, cool it off every now and then.

Amber, to Unite Broken Pieces.—Coat with linseed oil the surfaces that are to be joined; hold the oiled parts carefully over a charcoal fire, a few hot cinders or a gaslight, being careful to cover up all the rest of the object loosely with paper. When the oiled parts have begun to feel the heat so as to be sticky, press and clamp them together and keep them so until nearly cold. Only that part where the edges are to be united must be warmed, and even that with care lest the form or polish of the other parts should be disturbed; the part where the joint occurs generally requires to be repolished.

Imitation Amber.—Of late, an imitation of amber, which cannot be distinguished from the genuine article by inspection, has made its appearance on the market. It contains copal, camphor, turpentine, and other ingredients, becomes electric by friction, and is used for manufacturing mouthpieces for pipes, cigar-holders, ornaments, etc. The composition may be distinguished from genuine amber by its lower melting point, as it quickly softens and melts when laid on a hot plate, while amber requires a comparatively high heat; and further by the action of ether, which softens the imitation until it may be scraped away with the finger-nail, while true amber is absolutely insoluble in cold ether.

Annealing and Hardening.

For the best methods of annealing, hardening and tempering steel, see article STEEL in this volume. Several valuable facts in regard to glass are also given under GLASS.

Copper, brass, German silver and similar metals are hardened by hammering, rolling or wire drawing, and are softened by being heated red hot and plunged in water. Copper, by being alloyed with tin, may be made so hard that cutting instruments may be made of it. This is the old process of hardening copper, which is so often claimed to be one of the lost arts, and which would be very useful if we did not have

in steel a material which is far less costly and far better fitted for the making of edge tools.

Antiseptic Preparations.

Specimens of natural history intended for subsequent examination and dissection are best preserved in alcohol, but as this is expensive, a saturated solution of 100 parts of alum and 2 parts of saltpetre may be used with good effect. For preserving stuffed specimens the following are generally used :

Arsenical Soap.—This is the most powerful preservative in use. It is a strong poison, but is invaluable for preserving skins of birds and beasts that are to be stuffed. It is made thus : Powdered arsenic, 2 oz. ; camphor, 5 oz. ; white soap, 2 oz. ; salt of tartar (sub-carbonate of potash), 6 drachms ; powdered lime, 2 drachms. Cut the soap in very thin slices and heat gently with a small quantity of water, stirring all the time with a stick. When thoroughly melted add the salt of tartar and the lime. When these are well mixed together add the arsenic, which must be carefully incorporated with the other ingredients. Take the mixture off the fire, and while cooling add the camphor, previously reduced to powder by rubbing it with a little alcohol. When finished the soap should be of the consistence of thick cream and should be kept in a tightly stopped bottle.

Arsenical Preservative Powder.—This is dusted over moist skins and flesh, and preserves almost any animal matter from putrefaction. It is thus made : Arsenic, 4 oz. ; burnt alum, 4 oz. ; tanner's bark, 8 oz ; mix and grind together to a very fine powder.

Beeswax.

Beeswax is obtained by washing and melting the honeycomb. The product is yellow and is freed from its impurities, and bleached by melting it with hot water or steam, in a tinned copper or wooden vessel, letting it settle, running it off into an oblong trough with a line of holes in its bottom, so as to distribute it upon horizontal wooden cylinders, made to revolve, half immersed in cold water, and then exposing the thin ribbons or films thus obtained, to the blanching action of air, light, and moisture. For this purpose the ribbons are laid upon long webs of canvas stretched horizontally between standards, two feet above the surface of a sheltered

field, having a free exposure to the sunbeams. Here they are frequently turned over, then covered by nets to prevent their being blown away by winds, and watered from time to time, like linen upon the grass field in the old method of bleaching. Whenever the color of the wax seems stationary, it is collected, re-melted, and thrown again into ribbons upon the wet cylinder, in order to expose new surfaces to the bleaching operation. By several repetitions of these processes, if the weather proves favorable, the wax becomes quite white.

Black-boards.

Various kinds of so-called "liquid slating" have been sold for converting any smooth board or wall into a black-board for school or other purposes. The following give very good results; No. 1 is probably the best, but is somewhat expensive.

1. Take alcohol (95 per cent.), 4 pints; shellac, 8 ounces; lamp-black, 12 drachms; ultramarine blue, 20 drachms; powdered rotten stone, 4 ounces; powdered pumice stone, 6 ounces. First dissolve the shellac in the alcohol, then add the other ingredients, finely powdered, and shake well. To apply the slating, have the surface of the board smooth and perfectly free from grease. Shake well the bottle containing the preparation, pour out a small quantity only into an old tea-cup, and apply it with a new flat varnish brush as rapidly as possible. Keep the bottle well corked, and shake it up every time before pouring out the liquid.

2. Instead of alcohol take a solution of borax in water; dissolve the shellac in this and color with lamp-black.

3. Dilute silicate of soda (water-glass) with an equal bulk of water, and add sufficient lamp-black to color it. The lamp-black should be ground with water and a little of the silicate before being added to the rest of the liquid.

Brass.

Next to iron, brass is probably the most generally useful metal, and as the varieties of this alloy are almost infinite, the range of purposes to which it may be applied is very great. The color of the alloy inclines to red when the proportion of zinc is small, gradually changing to yellow, and ultimately white, when the proportion of zinc is very large. The ductility and malleability of the alloy increase with the quantity of copper. Ordinary brass may be hammered, rolled into

sheets or drawn to wire while cold, provided it is occasionally annealed by heating it to a very low red heat. When worked hot it crumbles to pieces under the hammer or between the rolls. But the so-called yellow metal, or Muntz metal, an alloy of 40 parts of zinc and 60 of copper, may be wrought while red hot, rolled into sheets and forged into bolts. Brass is not so readily oxidized as copper, being harder, tougher, more easily fusible and more fluid when molten. It solidifies without becoming honey-combed, and hence is suited for making all kinds of castings; while simply by the addition of from 1 to 2 per cent. of lead, it is capable of being readily worked on the lathe, and may then be filed without, as it otherwise does, clogging the teeth of the file.

Finishing Brass.—The article having been brought to proper shape by means of the lathe, file, grindstone or other means, the surface must be rendered smooth and free from lumps, utters, or scratches. If finished in the lathe, emery paper and oil may be used to smooth the surface, the final polish being imparted by rouge. In all cases where brass or other metals are polished by means of abrasive materials, great care must be taken that all corners are left sharp and well-defined, since nothing looks so badly as a corner which ought to be square but which is worn and rounded in the process of polishing.

In finishing brass work (and the same remark applies to the polishing of other materials) great care must be taken to avoid making any scratches which are deeper than the other marks left by the material employed. Such scratches are very difficult to remove by very fine files or by polishing powders, and therefore, whenever the work shows such scratches it is necessary to go back to the coarse file or scraper and begin anew. (See articles on *Polishing Metals* and *Polishing Powders.*)

Coloring and Varnishing Brass.—To prevent the everyday rusting of brass goods, the trade has long resorted to means for protecting the surface from the action of the atmosphere, the first plan of which is to force a change to take place. Thus, if brass is left in damp sand, it acquires a beautiful brown color, which, when polished with a dry brush, remains permanent and requires no cleaning. It is also possible to impart a green and light coating of verdigris on the surface of the brass by means of dilute acids, allowed to dry spon-

taneously. The antique appearance thus given is very pleasing, and more or less permanent. But it is not always possible to wait for goods so long as such processes require, and hence more speedy methods became necessary, many of which had to be further protected by a coat of varnish. Before bronzing, however, all the requisite fitting is finished, and the brass annealed, pickled in old or dilute nitric acid, till the scales can be removed from the surface, scoured with sand and water, and dried. Bronzing is then performed according to the color desired; for although the word means a brown color, being taken from the Italian "*bronzino*," signifying burnt brown, yet in commercial language it includes all colors. (*See article on Bronzing.*)

Browns of all shades are obtained by immersion in solutions of nitrate or the perchloride of iron; the strength of the solutions determining the depth of the color. Violets are produced by dipping in a solution of chloride of antimony. Chocolate is obtained by burning on the surface of the brass moist red oxide of iron, and polishing with a very small quantity of blacklead.

Olive-green results from making the surface black by means of a solution of iron and arsenic in muriatic acid, the details of the process being as follows:

Make the articles bright, then dip in aqua fortis, which must be thoroughly rinsed off with clean water. Then make the following mixture: Hydrochloric acid, 6 lbs.; sulphate of iron, ½ lb.; white arsenic, ½ lb. Be careful to get all the ingredients pure. Let the articles lie in the mixture till black; take out and dry in hot sawdust, polish with blacklead, and lacquer with green lacquer composed of one part lac varnish, four of turmeric, and one of gamboge.

A steel-gray color is deposited on brass from a dilute boiling solution of chloride of arsenic; and a blue by careful treatment with strong hyposulphite of soda.

Black is much used for optical brass work, and is obtained by coating the brass with a solution of platinum, or with chloride of gold mixed with nitrate of tin. The Japanese bronze their brass by boiling it in a solution of sulphate of copper, alum and verdigris.

Success in the art of bronzing greatly depends on circumstances, such as the temperature of the alloy or of the solution, the proportions of the metals used in forming the alloy,

and the quality of the materials. The moment at which to withdraw the goods, the drying of them, and a hundred little items of care and manipulation, require attention which experience alone can impart.

To avoid giving any artificial color to brass, and yet to preserve it from becoming tarnished, it is usual to cover properly cleaned brass with a varnish called "lacquer." To prepare the brass for this, the goods, after being annealed, pickled, scoured and washed, as already explained, are either dipped for an instant in pure commercial nitrous acid, washed in clean water, and dried in sawdust, or immersed in a mixture of one part of nitric acid with four of water, till a white curd covers the surface, at which moment the goods are withdrawn, washed in clean water, and dried in sawdust. In the first case the brass will be bright; in the latter, a dead flat which is usually relieved by burnishing the prominent parts. Then the goods are dipped for an instant in commercial nitric acid, and well washed in water containing some argol (to preserve the color till lacquered), and dried in warm sawdust. So prepared, the goods are conveyed to the lacquer room, where they are heated on a hot plate and varnished.

The varnish used is one of spirit, consisting, in its simple form, of one ounce of shellac dissolved in one pint of alcohol. To this simple varnish are added such coloring substances as red sanders, dragon's-blood, and annatto, for imparting richness of color. To lower the tone of color, turmeric, gamboge, saffron, Cape aloes, and sandarac are used. The first group reddens, the second yellows the varnish, while a mixture of the two gives a pleasing orange. (*See article on Lacquer.*)

To Whiten Brass.—Small articles of brass or copper may be whitened by boiling them in a solution of ¾ lb. cream of tartar, 2 quarts of water, and 1 lb. grain tin or any pure tin finely divided. The tin dissolves in the cream of tartar and is again precipitated on the brass or copper.

Depositing Brass by Electricity.—The first step is to thoroughly cleanse the articles, either by means of emery, or by laying them overnight in a weak bath of sulphuric acid. They are then washed off with water, a weak soda solution, and then immersed as the cathode of a bath consisting of 2½ parts of sulphate of copper, 20 parts sulphate of zinc, and 45 parts cyanide of potassium, in 300 parts of water. The anode should be two plates of zinc and copper of equal size. The

color of the resulting brass coating may be modified by varying the depth of immersion of one or the other of the plates. The galvanic current should be a strong one, and the liberation of hydrogen bubbles on the object to be brassed should be plentiful. It is important, however, to note that the objects should be first coppered to insure a strong attachment of the brass coating.

Coating Brass with Copper.—The following valuable process for coating brass with copper, is given by Dr. C. Puscher: Dissolve ten parts, by weight, of sulphate of copper, and five of sal-ammoniac, in one hundred and fifty parts, by weight, of water. Place the brass, well cleaned and free from fatty matter on its surface, into this mixture; leave it in it for a minute; let the excess of liquid drain off first, and heat the metal next over a charcoal fire, until the evolution of ammoniacal vapors ceases, and the coppery film appears perfect. Wash with cold water and dry. The coating of copper adheres firmly.

Cleaning Brass.—Large articles of brass and copper which have become very much soiled may be cleaned by a mixture of rotten-stone powder (or any sharp polishing powder) with a strong solution of oxalic acid. After being thoroughly cleaned, the metal should be wiped off with a cloth moistened with soda or potash, and a very light coating of oil should be applied to prevent the further corroding action of the acid.

A more powerful cleaning agent, because very corrosive, is finely powdered bichromate of potash mixed with twice its bulk of strong sulphuric acid and diluted (after standing an hour or so) with an equal bulk of water. This will instantly clean the dirtiest brass, but great care must be taken in handling the liquid, as it is very corrosive.

Brass which has been lacquered should never be cleaned with polishing powders or corrosive chemicals. Wiping with a soft cloth is sufficient, and in some cases washing with weak soap and water may be admissible. Dry the articles thoroughly, taking care not to scratch them, and if, after this, they show much sign of wear or corrosion, send them to the lacquerer to be refinished.

Brazing and Soldering.

The term *soldering* is generally applied when fusible alloys of lead and tin are employed for uniting metals. When hard

metals, such as copper, brass or silver are used, the term *brazing* (derived from brass) is more appropriate.

In uniting tin, copper, brass, etc., with any of the soft solders, a copper soldering-iron is generally used. This tool and the manner of using it are too well known to need description. In many cases, however, the work may be done more neatly without the soldering-iron, by filing or turning the joints so that they fit closely, moistening them with the soldering fluid described hereafter, placing a piece of smooth tin-foil between them, tying them together with binding wire, and heating the whole in a lamp or fire till the tin-foil melts. We have often joined pieces of brass in this way so that the joints were quite invisible. Indeed, with good soft solder almost all work may be done over a spirit lamp or even a candle, without the use of a soldering-iron.

More minute directions may be found in the *Young Scientist*, Vol. I, page 56.

Advantage may be taken of the varying degrees of fusibility of solders to make several joints in the same piece of work. Thus, if the first joint has been made with fine tinner's solder, there would be no danger of melting it in making a joint near it with bismuth solder, composed of lead, 4; tin, 4; and bismuth, 1; and the melting point of both is far enough removed from that of a solder composed of lead, 2; tin, 1; and bismuth, 2; to be in no danger of fusion during the use of the latter.

Soft solders do not make malleable joints. To join brass, copper or iron so as to have the joint very strong and malleable, hard solder must be used. For this purpose equal parts of silver and brass will be found excellent, though for iron, copper, or very infusible brass, nothing is better than silver coin rolled out thin, which may be done by any silversmith or dentist. This makes decidedly the toughest of all joints, and as a little silver goes a long way, it is not very expensive.

For most hard solders borax is the best flux. It dissolves any oxides which may exist on the surface of the metal, and protects the latter from the further action of the air, so that the solder is enabled to come into actual contact with the surfaces which are to be joined. For soft solders the best flux is a soldering fluid which may be prepared by saturating hydrochloric acid (spirit of salt) with zinc. The addition of

a little sal ammoniac improves it. It is said that a solution of phosphoric acid in alcohol makes an excellent soldering fluid, which has some advantages over chloride of zinc.

In using ordinary tinner's solder for uniting surfaces that are already tinned—such as tinned plate and tinned copper—resin is the best and cheapest flux, but when surfaces of iron, brass or copper that have not been tinned are to be joined by soft solder, the soldering fluid is by far the most convenient. Resin possesses this important advantage over soldering fluid, that it does not induce subsequent corrosion of the article to which it is applied. When acid fluxes have been applied to anything that is liable to rust, it is necessary to see that they are thoroughly washed off with clean warm water and the articles carefully and thoroughly dried.

Oil and powdered resin mixed together make a good flux for tinned articles. The mixture can be applied with a small brush or a swab tied to the end of a stick.

In preparing solders, whether hard or soft, great care is requisite to avoid two faults—a want of uniformity in the melted mass, and a change in the proportions of the constituents by the loss of volatile or oxidable ingredients. Thus, where copper, silver, and similar metals are to be mixed with tin, zinc, etc., it is necessary to melt the more infusible metal first. When copper and zinc are heated together, a large portion of the zinc passes off in fumes. In preparing soft solders, the material should be melted under tallow, to prevent waste by oxidation; and in melting hard solders, the same object is accomplished by covering them with a thick layer of powdered charcoal.

To obtain hard solders of uniform composition, they are generally granulated by pouring them into water through a wet broom. Sometimes they are cast in solid masses and reduced to powder by filing. Silver solders for jewelers are generally rolled into thin plates, and sometimes the soft solders, especially those that are very fusible, are rolled into sheets and cut into narrow strips, which are very convenient for small work that is to be heated by a lamp.

The following simple mode of making solder wire, which is very handy for small work, will be found useful. Take a sheet of stiff writing or drawing paper, and roll it in a conical form, rather broad in comparison with its length. Make a ring of stiff wire, to hold it in, attaching a suitable handle

to the ring. The point of the cone may first of all be cut off, to leave an orifice of the size required. When filled with molten solder it should be held above a pail of cold water, and the stream of solder flowing from the cone will congeal as it runs, and form the wire. If held a little higher, so that the stream of solder breaks into drops, before striking the water, it will form handy, elongated "tears" of metal; but, by holding it still higher, each drop forms a thin concave cup or shell, and, as each of these forms have their own peculiar uses in business, many a mechanic will find this hint very useful.

Hard solders are usually reduced to powder either by granulation or filing, and then spread along the joints after being mixed with borax, which has been fused and powdered. It is not necessary that the grains of solder should be placed *between* the pieces to be joined, as with the aid of the borax they will "sweat" into the joint as soon as fusion takes place. The same is true of soft solder applied with soldering fluid. One of the essential requisites of success, however, is that the surfaces be clean, bright, and free from all rust.

The best solder for platinum is fine gold. The joint is not only very infusible, but it is not easily acted upon by common agents. For German-silver joints, an excellent solder is composed of equal parts of silver, brass, and zinc. The proper flux is borax.

Bronzing.

Two distinct processes have had this name applied to them. The first consists in staining brass work a dark brown or bronze color and lacquering it; the second consists in partially corroding the brass so as to give it that greenish hue which is peculiar to ancient brass work. The first is generally applied to instruments and apparatus, the second to articles of ornament.

Bronze for Brass Instruments.—1. The cheapest and simplest is undoubtedly a light coat of plumbago or black lead. After brushing the article with plumbago place it on a clear fire till it is made too hot to be touched. Apply a plate brush as soon as it ceases to be hot enough to burn the brush. A few strokes of the brush will produce a dark brown polish approaching black, but entirely distinct from the well known appearance of black lead. Lacquer with any desired tint.

2. Plate powder or rouge may be used instead of plumbago, and gives very beautiful effects.

3. Make the articles clean, bright and free from oil or grease, then dip in aqua fortis, which must be thoroughly rinsed off with clean warm water. Then make the following mixture: Hydrochloric acid, 6 lbs.; sulphate of iron, ½ lb.; white arsenic, ½ lb. Be careful to get all the ingredients pure. Let the articles lie in the mixture till black, take out and dry in hot sawdust, polish with black lead, and lacquer with green lacquer.

Antique Bronze.—Dissolve 1 oz. sal-ammoniac, 3 oz. cream tartar, and 6 oz. common salt in 1 pint of hot water; add 2 oz. nitrate of copper dissolved in ½ pint of water; mix well, and, by means of a brush, apply it repeatedly to the article, which should be placed in a damp situation.

Bronzing Liquid.—Dissolve 10 parts of fuchsine and 5 parts of aniline-purple in 100 parts of 95 per cent. alcohol on a water bath; after solution has taken place, add 5 parts of benzoic acid, and keep the whole boiling for 5 or 10 minutes, until the green color of the mixture has given place to a fine light bronze-brown. This liquid may be applied to all metals, as well as many other substances, yields a very brilliant coating, and dries quickly. It is applied with a brush.

Bronzing Wood, Leather, Paper, etc.—1. Dissolve gum lac in four parts by volume of pure alcohol, and then add bronze or any other metal powder in the proportion of one part to three parts of the solution. The surface to be covered must be very smooth. In the case of wood, one or several coats of Mendon or Spanish white are given, and the object is carefully polished. The mixture is painted on, and when a sufficient number of coats have been given, the object is well rubbed. A special advantage of this process is that the coating obtained is not dull, but can be burnished.

2. Another method is to coat the object with copal or other varnish, and when this has dried so far as to become "tacky" dust bronze powder over it. After a few hours the bronzed surface should be burnished with a burnisher of steel or agate.

Browning Gun Barrels. *(See Guns.)*

Burns.

Those who work in red-hot metals, glass blowing, etc., are sometimes apt to burn their fingers. It is well to know that a solution of bicarbonate of soda (baking soda) promptly and permanently relieves all pain. The points to be observed are: 1. Bicarbonate of soda must be used; washing soda and common soda are far too irritant to be applied if the burn is serious. 2. The solution must be saturated. 3. The solution must be ice-cold.

A laboratory assistant in Philadelphia having severely burned the inside of the last joint of his thumb while bending glass tubing, applied the solution of bicarbonate of soda, and not only was the pain allayed, but the thumb could be at once freely used without inconvenience.

Case-Hardening. *(See Iron.)*

Catgut.

This material is so valuable for many purposes that many mechanics will find it useful to know how to make it, as they can then provide themselves with any size and length that may be needed. The process is quite simple. Take the entrails of sheep or other animals, remembering that fat animals afford a very weak string, while those that are lean produce a much tougher article, and thoroughly clean them from all impurities, attached fat, etc. The animal should be newly killed. Wash well in clean water and soak in soft water for two days, or in winter for three days; lay them on a table or board and scrape them with a small plate of copper having a semicircular hole cut in it, the edges of which must be quite smooth and not capable of cutting. After washing put them into fresh water and then let them remain till the next day, when they are to be well scraped. Let them soak again in water for a night, and two or three hours before they are taken out add to each gallon of water 2 oz. of potash. They ought now to scrape quite clean from their inner mucous coat, and will consequently be much smaller in dimensions than at first. They may now be wiped dry, slightly twisted, and passed through a hole in a piece of brass to equalize their size; as they dry they are passed every two or three hours through other holes, each smaller than the last. When dry they will be round and well polished, and after being oiled are fit for use.

Cements.

General Rules.—Some years ago the writer called attention* to the fact that quite as much depends upon the manner in which a cement is used as upon the cement itself. The best cement that ever was compounded would prove entirely worthless if improperly applied. The following rules must be vigorously adhered to if success would be secured:

1. Bring the cement into intimate contact with the surfaces to be united. This is best done by heating the pieces to be joined in those cases where the cement is melted by heat, as in using resin, shellac, marine glue, etc. Where solutions are used, the cement must be well rubbed into the surfaces either with a soft brush (as in the case of porcelain or glass), or by rubbing the two surfaces together (as in making a glue joint between two pieces of wood.)

2. As little cement as possible should be allowed to remain between the united surfaces. To secure this the cement should be as liquid as possible (thoroughly melted if used with heat), and the surfaces should be pressed closely into contact (by screws, weights, wedges or cords) until the cement has hardened.

Where the cement is a solution (such as gum in water) and the surfaces are very absorbent (such as porous paper), the surfaces must be *saturated* with cement before they are brought together.

4. Plenty of time should be allowed for the cement to dry or harden, and this is particularly the case in *oil* cements such as copal varnish, boiled oil, white lead, etc. When two surfaces, each half an inch across, are joined by means of a layer of white lead placed between them, six months may elapse before the cement in the middle of the joint has become hard. In such cases a few days or weeks are of no account; at the end of a month the joint will be weak and easily separated, while at the end of two or three years it may be so firm that the material will part anywhere else than at the joint. Hence, where the article is to be used immediately, the only safe cements are those which are liquified by heat and which become hard when cold. A joint made with marine glue is firm an hour after it has been made. Next to cements that are liquified by heat, are those which consist

*Technologist, Vol. I (1870), page 188.

of substances dissolved in water or alcohol. A glue joint sets firmly in twenty-four hours; a joint made with shellac varnish becomes dry in two or three days. Oil cements, which do not dry by evaporation, but harden by oxidation (boiled oil, white lead, red lead, etc.), are the slowest of all.

Aquarium Cement.—Litharge; fine, white, dry sand and plaster of paris, each 1 gill; finely pulverized resin, ⅓ gill. Mix thoroughly and make into a paste with boiled linseed oil to which dryer has been added. Beat it well, and let it stand four or five hours before using it. After it has stood for 15 hours, however, it loses its strength. Glass cemented into its frame with this cement is good for either salt or fresh water. It has been used at the Zoölogical Gardens, London, with great success. It might be useful for constructing tanks for other purposes or for stopping leaks.

Armenian Cement.—The jewellers of Turkey, who are mostly Armenians, have a singular method of ornamenting watch cases, etc., with diamonds and other precious stones by simply gluing or cementing them on. The stone is set in gold or silver, and the lower part of the metal made flat or to correspond with that part to which it is to be fixed. It is then warmed gently and the glue applied, which is so very strong that the parts thus cemented never separate. This glue, which will firmly unite bits of glass and even polished steel, and may, of course, be applied to a vast variety of useful purposes, is thus made : Dissolve five or six bits of gum mastic, each the size of a large pea, in as much alcohol as will suffice to render it liquid; in another vessel dissolve as much isinglass, previously a little softened in water, (though none of the water must be used,) in good brandy or rum, as will make a two-ounce phial of very strong glue, adding two small bits of gum galbanum, or ammoniacum, which must be rubbed or ground until they are dissolved. Then mix the whole with a sufficient heat, keep the glue in a phial closely stopped, and when it is to be used set the phial in boiling water. To avoid the cracking of the phial by exposure to such sudden heat, use a thin green glass phial, and hold it in the steam for a few seconds before immersing it in the hot water.

Buckland's Cement.—Finely powdered white sugar, 1 oz.; finely powdered starch, 3 oz.; finely powdered gum arabic, 4 oz. Rub well together in a dry mortar; then little by little

add cold water until it is of the thickness of melted glue; put in a wide mouthed bottle and cork closely. The powder, thoroughly ground and mixed, may be kept for any length of time in a wide mouthed bottle, and when wanted a little may be mixed with water with a stiff brush. It answers ordinarily for all the purposes for which mucilage is used, and as a cement for labels it is specially good, as it does not become brittle and crack off.

Casein Mucilage.—Take the curd of skim-milk (carefully freed from cream or oil), wash it thoroughly and dissolve it to saturation in a cold concentrated solution of borax. This mucilage keeps well, and as regards adhesive power far surpasses the mucilage of gum arabic.

Casein and Soluble Glass.—Casein dissolved in soluble silicate of soda or potassa, makes a very strong cement for glass or porcelain.

Cheese Cement for mending China, etc.—Take skim milk cheese, cut it in slices and boil it in water. Wash it in cold water and knead it in warm water several times. Place it warm on a levigating stone and knead it with quicklime. It will join marble, stone or earthenware so that the joining is scarcely to be discovered.

Chinese Cement (Schio-liao).—To three parts of fresh beaten blood are added four parts of slaked lime and a little alum; a thin, pasty mass is produced, which can be used immediately. Objects which are to be made specially water-proof are painted by the Chinese twice, or at the most three times. Dr. Scherzer saw in Pekin a wooden box which had travelled the tedious road via Siberia to St. Petersburg and back, which was found to be perfectly sound and water-proof. Even baskets made of straw became, by the use of this cement, perfectly serviceable in the transportation of oil. Pasteboard treated therewith receives the appearance and strength of wood. Most of the wooden public buildings of China are painted with schio-liao, which gives them an unpleasant reddish appearance, but adds to their durability. This cement was tried in the Austrian department of Agriculture, and by the "Vienna Association of Industry," and in both cases the statements of Dr. Scherzer were found to be strictly accurate.

Chinese Glue.—Shellac dissolved in alcohol. Used for joining wood, earthenware, glass, etc. This cement requires

considerable time to become thoroughly hard, and even then is not as strong as good glue. Its portability is its only recommendation.

Faraday's Cap Cement.—Electrical Cement.—Resin, 5 oz.; beeswax 1 oz.; red ochre or Venetian red in powder, 1 oz. Dry the earth thoroughly on a stove at a temperature above 212°. Melt the wax and resin together and stir in the powder by degrees. Stir until cold, lest the earthy matter settle to the bottom. Used for fastening brass work to glass tubes, flasks, etc.

Glass, Earthenware, etc., Cement for.—Dilute white of egg with its bulk of water and beat up thoroughly. Mix to the consistence of thin paste with powdered quicklime. Must be used immediately.

Glass Cement.—Take pulverized glass, 10 parts; powdered fluorspar, 20 parts; soluble silicate of soda, 60 parts. Both glass and fluorspar must be in the finest possible condition, which is best done by shaking each, in fine powder, with water, allowing the coarser particles to deposit, and then to pour off the remainder which holds the finest particles in suspension. The mixture must be made very rapidly, by quick stirring, and when thoroughly mixed must be at once applied. This is said to yield an excellent cement.

Glue is undoubtedly the most important cement used in the arts. Good glue is hard, clear (not necessarily light-colored, however,) and free from bad taste and smell. Glue which is easily dissolved in *cold* water is not strong. Good glue merely swells in cold water and must be heated to the boiling point before it will dissolve thoroughly.

Good glue requires more water than poor, consequently you cannot dissolve six pounds of good glue in the same quantity of water you can six pounds of poor. The best glue, which is clear and red, will require from one-half to more than double the water that is required with poor glue, and the quality of which can be discovered by breaking a piece. If good, it will break hard and tough, and when broken will be irregular on the broken edge. If poor, it will break comparatively easy, leaving a smooth, straight edge.

In dissolving glue, it is best to weigh the glue, and weigh or measure the water. If not done there is a liability of getting more glue than the water can properly dissolve. It is a good plan, when once the quantity of water that any sample

of glue will take up has been ascertained, to put the glue and water together at least six hours before heat is applied, and if it is not soft enough then, let it remain longer in soak, for there is no danger of good glue remaining in pure water, even for forty-eight hours.

From careful experiments with dry glue immersed for twenty-four hours in water at 60° Fah., and thereby transformed into a jelly, it was found that the finest ordinary glue, or that made from white bones, absorbs twelve times its weight of water in twenty-four hours; from dark bones, the glue absorbs nine times its weight of water; while the ordinary glue made from animal refuse, absorbs but three to five times its weight of water.

Glue, being an animal substance, it must be kept sweet; to do this it is necessary to keep it cool after it is once dissolved, and not in use. In all cases keep the glue-kettle clean and sweet, by cleansing it often.

Great care must be taken not to burn it, and, therefore, it should always be prepared in a water bath.

Carpenters should remember that fresh glue dries more readily than that which has been once or twice melted.

The advantage of frozen glue is that it can be made up at once, on account of its being so porous. Frozen glue of same grade is as strong as if dried.

If glue is of first-rate quality, it can be used on most kinds of wood work very thin, and make the joint as strong as the original. White glue is only made white by bleaching.

Glue, Liquid.—1. A very strong glue may be made by dissolving 4 oz. of glue in 16 ounces of strong acetic acid by the aid of heat. It is semi-solid at ordinary temperatures, but needs only to be warmed, by placing the vessel containing it into hot water, to be ready for use.

2. Dilute officinal phosphoric acid with two parts, by weight of water, and saturate with carbonate of ammonia; dilute the resulting liquid, which must be still somewhat acid, with another part of distilled water, warm it on a water-bath, and dissolve in it enough good glue to form a thick, syrupy liquid. It must be kept in well-closed bottles.

3. A most excellent form is also *Dumoulin's Liquid and Unalterable Glue.* This is made as follows: Dissolve 8 oz. of best glue in ½ pint of water in a wide-mouthed bottle, by heating the bottle in a water-bath. Then add slowly 2½ oz.

of nitric acid, spec. gr. 1330, stirring constantly. Effervescence takes place under escape of nitrous acid gas. When all the acid has been added, the liquid is allowed to cool. Keep it well corked, and it will be ready for use at any moment. It does not gelatinize, or putrefy or ferment. It is applicable to many domestic uses, such as mending china, wood, etc.

Glue, Mouth.—Good glue, 1 lb.; isinglass, 4 oz. Soften in water, boil and add ½ lb. fine brown sugar. Boil till pretty thick and pour into moulds.

Glue, Portable.—Put a pinch of shredded gelatine into a wide-mouthed bottle; put on it a very little water, and about one-fourth part of glacial acetic acid; put in a well-fitting cork. If the right quantity of water and acid be used, the gelatine will swell up into worm-like pieces, quite elastic, but at the same time, firm enough to be handled comfortably. The acid will make the preparation keep indefinitely. When required for use, take a small fragment of the swelled gelatine, and warm the end of it in the flame of a match or candle; it will immediately "run" into a fine clear glue, which can be applied at once direct to the article to be mended. The thing is done in half a minute, and is, moreover, done well, for the gelatine so treated makes the very best and finest glue that can be had. This plan might be modified by dissolving a trace of chrome alum in the water used for moistening the gelatine, in which case, no doubt, the glue would become insoluble when set. But for general purposes, there is no need for subsequent insolubility in glue.

Gutta-Percha Cement.—This highly recommended cement is made by melting together, in an iron pan, 2 parts common pitch and 1 part gutta-percha, stirring them well together until thoroughly incorporated, and then pouring the liquid into cold water. When cold it is black, solid, and elastic; but it softens with heat, and at 100° Fahr. is a thin fluid. It may be used as a soft paste, or in the liquid state, and answers an excellent purpose in cementing metal, glass, porcelain, ivory, &c. It may be used instead of putty for glazing windows.

Iron Cement for closing the Joints of Iron Pipes.—Take of coarsely powdered iron borings, 5 pounds; powdered sal-ammoniac, 2 oz.; sulphur, 1 oz.; and water sufficient to moisten it. This composition hardens rapidly; but if time

can be allowed it sets more firmly without the sulphur. It must be used as soon as mixed and rammed tightly into the joints.

2. Take sal-ammoniac, 2 oz.; sublimed sulphur, 1 oz.; cast-iron filings or fine turnings, 1 lb. Mix in a mortar and keep the powder dry. When it is to be used, mix it with twenty times its weight of clean iron turnings, or filings, and grind the whole in a mortar; then wet it with water until it becomes of convenient consistence, when it is to be applied to the joint. After a time it becomes as hard and strong as any part of the metal.

Japanese Cement.—Paste made of fine rice flour.

Kerosene Oil Lamps.—The cement commonly used for fastening the tops on kerosene lamps is plaster of paris, which is porous and quickly penetrated by the kerosene. Another cement which has not this defect is made with three parts of resin, one of caustic soda and five of water. This composition is mixed with half its weight of plaster of paris. It sets firmly in about three-quarters of an hour. It is said to be of great adhesive power, not permeable to kerosene, a low conductor of heat and but superficially attacked by hot water.

Labels, Cement for.—1. Macerate 5 parts of good glue in 18 parts of water. Boil and add 9 parts rock candy and 3 parts gum arabic.

2. Mix dextrine with water and add a drop or two of glycerine.

3 A mixture of 1 part of *dry* chloride of calcium, or 2 parts of the same salt in the *crystallized* form, and 36 parts of gum arabic, dissolved in water to a proper consistency, forms a mucilage which holds well, does not crack by drying, and yet does not attract sufficient moisture from the air to become wet in damp weather.

4. For attaching labels to tin and other bright metallic surfaces, first rub the surface with a mixture of muriatic acid and alcohol; then apply the label with a very thin coating of the paste, and it will adhere almost as well as on glass.

5. To make cement for attaching labels to metals, take ten parts tragacanth mucilage, ten parts of honey, and one part flour. The flour appears to hasten the drying, and renders it less susceptible to damp. Another cement that will resist the damp still better, but will not adhere if the surface is

greasy, is made by boiling together two parts shellac, one part borax, and sixteen parts water. Flour paste to which a certain proportion of nitric acid has been added, and heat applied, makes a lasting cement, but the acid often acts upon the metals. The acid converts the starch into dextrine.

6. The *Archives of Pharmacy* gives the following recipe for damp-proof mucilage for labels: Macerate five parts of good glue in eighteen to twenty parts of water for a day, and to the liquid add nine parts of rock candy and three parts of gum arabic. The mixture can be brushed upon paper while lukewarm; it keeps well, does not stick together, and, when moistened, adheres firmly to bottles. For the labels of soda or seltzer-water bottles, it is well to prepare a paste of good rye flour and glue, to which linseed-oil, varnish, and turpentine have been added, in the proportion of half an ounce each to the pound. Labels prepared in the latter way do not fall off in damp cellars.

Leather and Metal, Cement for Uniting.—Wash the metal with hot gelatine; steep the leather in an infusion of nut galls (hot) and bring the two together.

Leather Belting, Cement for.—One who has tried everything says that after an experience of fifteen years he has found nothing to equal the following: Common glue and isinglass, equal parts, soaked for 10 hours in just enough water to cover them. Bring gradually to a boiling heat and add pure tannin until the whole becomes ropy or appears like the white of eggs Buff off the surfaces to be joined, apply this cement warm, and clamp firmly.

Litharge and Glycerine Cement.—A cement made of very finely powdered oxide of lead (litharge) and concentrated glycerine, unites wood to iron with remarkable efficiency. The composition is insoluble in most acids, is unaffected by the action of moderate heat, sets rapidly, and acquires an extraordinary hardness.

Marine Glue.—The true marine glue is a combination of shellac and caoutchouc in proportions which vary according to the purposes for which the cement is to be used. Some is very hard, others quite soft. The degree of softness is also regulated by the proportion of benzole used for dissolving the caoutchouc. Marine glue is more easily purchased than made, but where a small quantity is needed the following recipe is said to give very good results: Dissolve one part of

India-rubber in 12 parts of benzole, and to the solution add 20 parts of powdered shellac, heating the mixture *cautiously* over the fire. Apply with a brush.

The following recipe, taken from *New Remedies*, is said to yield a strong cement: 10 parts of caoutchouc or India-rubber are dissolved in 120 parts of benzine or petroleum (?) naphtha with the aid of a gentle heat. When the solution is complete, which sometimes requires 10 to 14 days, 20 parts of asphalt are melted in an iron vessel, and the caoutchouc solution is poured in very slowly, in a fine stream, and under continued heating, until the mass has become homogeneous, and nearly all of the solvent has been driven off. It is then poured out and cast into greased tin moulds. It forms dark-brown or black cakes, which are very hard to break. This cement requires considerable heat to melt it; and to prevent it from being burnt, it is best to heat a capsule containing a piece of it first on a water-bath, until the cake softens and begins to be liquid. It is then carefully wiped dry, and heated over a naked flame, under constant stirring, up to about 300° F. The edges of the article to be mended should, if possible, also be heated to at least 212° F., so as to permit the cement to be applied at leisure and with care. The thinner the cement is applied, the better it binds.

Metal, Cement for attaching to Glass.—Copal varnish, 15; drying oil, 5; turpentine, 3. Melt in a water-bath and add 10 parts slaked lime.

Paris Cement for mending Shells and other Specimens.—Gum arabic, 5; sugar candy, 2. White lead, enough to color.

Paste.—The best paste is made of good flour, well boiled. Resin, etc., do more harm than good.

2. An excellent white paste may be made by dissolving 2½ oz. gum arabic in 2 quarts hot water and thickening with wheat flour. To this is added a solution of alum and sugar of lead; the mixture is heated and stirred till about to boil, when it is allowed to cool.

3. Four parts, by weight, of glue are allowed to soften in 15 parts of cold water for some hours, and then moderately heated till the solution becomes quite clear. 65 parts of boiling water are now added with stirring. In another vessel 30 parts of starch paste are stirred up with 20 parts of cold water, so that a thin milky fluid is obtained without lumps. Into this the boiling glue solution is poured, with constant

stirring, and the whole is kept at the boiling temperature. After cooling, 10 drops of carbolic acid are added to the paste. This paste is of extraordinary adhesive power, and may be used for leather, paper, or cardboard with great success. It must be preserved in closed bottles to prevent evaporation of the water, and will, in this way, keep good for years.

4. Rice flour makes an excellent paste for fine paper work.

5. Gum tragacanth and water make an ever ready paste. A few drops of any kind of acid should be added to the water before putting in the gum, to prevent fermentation. This paste will not give that semi-transparent look to thin paper, that gum arabic sometimes gives, when used for mucilage.

Porcelain Cement.—Add plaster of paris to a strong solution of alum till the mixture is of the consistency of cream. It sets readily, and is said to unite glass, metal, porcelain, etc., quite firmly. It is probably suited for cases in which large rather than small surfaces are to be united.

Soft Cement.—Melt yellow beeswax with its weight of turpentine and color with finely powdered venetian red. When cold it has the hardness of soap, but is easily softened and moulded with the fingers, and for sticking things together temporarily it is invaluable.

Soluble Glass Cements.—When finely-pulverized chalk is stirred into a solution of soluble glass of 30° B until the mixture is fine and plastic, a cement is obtained which will harden in between six and eight hours, possessing an extraordinary durability, and alike applicable for domestic and industrial purposes. If any of the following substances be employed besides chalk, differently-colored cements of the same general character are obtained:—1. Finely pulverized or levigated stibnite (grey antimony, or black sulphide of antimony) will produce a dark cement, which, after burnishing with an agate, will present a metallic appearance. 2. Pulverized cast iron, a grey cement. 3. Zinc dust (so-called zinc grey), an exceedingly hard grey cement, which, after burnishing, will exhibit the white and brilliant appearance of metallic zinc. This cement may be employed with advantage in mending ornaments and vessels of zinc, sticking alike well to metals, stone, and wood. 4. Carbonate of copper, a bright green cement. 5. Sesquioxide of chromium, a dark green cement. 6. Thénard's blue (cobalt blue), a blue cement.

7. Minium, an orange-colored cement. 8. Vermilion, splendid red cement. 9. Carmine red, a violet cement.

Sorel's Cement.—Mix commercial zinc white with ½ its bulk of fine sand, adding a solution of chloride of zinc of 1·26 specific gravity, and rub the whole thoroughly together in a mortar. The mixture must be applied at once, as it hardens very quickly.

Steam Boiler Cement.—Mix two parts of finely powdered litharge with one part of very fine sand, and one part of quicklime which has been allowed to slack spontaneously by exposure to the air. This mixture may be kept for any length of time without injuring. In using it a portion is mixed into paste with linseed oil, or, still better, boiled linseed oil. In this state it must be quickly applied, as it soon becomes hard.

Transparent Cement for Glass.—Fine Canada balsam.

Turner's Cement.—Melt 1 lb. of resin in a pan over the fire, and, when melted, add a ¼ of a lb. of pitch. While these are boiling add brick dust until, by dropping a little on a cold stone, you think it hard enough. In winter it may be necessary to add a little tallow. By means of this cement a piece of wood may be fastened to the chuck, which will hold when cool; and when the work is finished it may be removed by a smart stroke with the tool. Any traces of the cement may be removed from the work by means of benzine.

Wollaston's White Cement for large objects.—Beeswax, 1 oz.; resin, 4 oz.; powdered plaster of paris, 5 oz. Melt together. To use, warm the edges of the specimen and use the cement warm.

Copper.

Copper is probably the most difficult of all the metals to work by the file or lathe, but pure copper may be cut like cheese with a graver, and consequently it is extensively used for plates where the number of impressions required is not very large. In filing copper the file should be well chalked, and in cutting it in the lathe use plenty of soapy water, and let the solution of soap be pretty strong. In polishing copper it will be found that owing to its softness, it burnishes easily (see article on *polishing* metals), but where it is polished by means of abrasive processes, that is, by the use of powders which grind it or wear it down, great care must be taken to

have the powders free from particles which are larger than the average, as these would be sure to scratch the metal, owing to its softness. For polishing copper by abrasion, only the softer polishing powders should be used, such as rotten stone, prepared chalk, and soft rouge. These are used with oil at first, but the last touches are given dry.

Copper may be welded by the use of proper fluxes. The best compound for this purpose is a mixture of one part of phosphate of soda and two parts of boracic acid. This welding powder should be strewn on the surface of the copper at a red heat; the pieces should then be heated up to a full cherry red, or yellow heat, and brought immediately under the hammer, when they may be as readily welded as iron itself. For instance, it is possible to weld together a small rod of copper which has been broken; the ends should be beveled, laid on one another, seized by a pair of tongs, and placed together with the latter in the fire and heated; the welding powder should then be strewn on the ends, which, after a further heating, may be welded so soundly as to bend and stretch as if they had never been broken. It is necessary to carefully observe two things in the course of the operation. First, the greatest care must be taken that no charcoal or other solid carbon comes into contact with the points to be welded, as otherwise phosphide of copper would be formed, which would cover the surface of the copper and effectually prevent a weld. In this case it is only by careful treatment in an oxidizing fire and a plentiful application of the welding powder that the copper can again be welded. It is, therefore, advisable to heat the copper in a flame, as, for instance, a gas flame. Second, as copper is a much softer metal than iron, it is much softer at the required heat than the latter at its welding heat, and the parts welded can not offer any great resistance to the blows of the hammer. They must, therefore, be so shaped as to be enabled to resist such blows as well as may be, and it is also well to use a wooden hammer, which does not exercise so great a force on account of its lightness. Mr. Rust, the inventor of this process, states that, as long ago as 1854, he welded strips of copper plates together and drew them into a rod; he also made a chain, the links of which had been made of pretty thick wire and welded.

Coppering Iron or Steel.—The following process is said to

give very good results: First make the article entirely bright by file, scratch brush, or any of the usual modes. Apply to the surface a coating of cream of tartar, then sprinkle the surface with a saturated solution of sulphate of copper, and rub with a hard brush. The coating of copper deposited on the iron is said to be very even and durable.

Coral, Artificial.

Twigs, raisin stalks, and any objects having the general outline of branched coral, may be made to resemble that material by being dipped in a mixture of 4 parts resin, 3 parts beeswax and 2 parts vermillion, melted together and thoroughly mixed. The effect is very pretty, and for ornamental work such imitation coral is very useful.

Cork.

Corks are so important in many operations, that a little knowledge of the best methods of working them is indispensable. They form the best material for a holder for sandpaper in rubbing down flat surfaces, and they afford the simplest and most effectual means of closing bottles in many cases. Cork is easily cut by means of a thin, sharp knife, which should not have a *smooth* edge, however, but one set on a dry stone, moderately fine. After having been cut to nearly the right form, corks are easily worked to the proper size and shape by means of files. Holes are easily made through corks by means of tin or brass tubes, which must be thin and well sharpened on the edge by means of a file. The sharp edge being slightly oiled, is pressed against the cork and at the same time turned round, when it quickly cuts a smooth straight hole through the material.

When it is desired to make corks air-tight and water-tight, the best method is to allow them to remain for about five minutes beneath the surface of melted paraffine in a suitable vessel, the corks being held down either by a perforated lid, wire screen, or similar device. Corks thus prepared can be easily cut and bored, have a perfectly smooth exterior, may be introduced and removed from the neck of a flask with ease, and make a perfect seal.

Crayons for Black-Boards.

Spanish white, which is simply very fine chalk, is mixed with water and just enough flour paste to cause the particles

to adhere when dry. If too much paste is used, the crayons will be too hard and will not mark well; if too soft, they will crumble. The proper proportions should be found by experiment, as different qualities of flour possess different adhesive properties. The wet chalk may be formed into proper shape by means of paper moulds, or it may be rolled out to the required shape and cut into suitable lengths.

For making drawings of objects of natural history, etc., it is frequenely desirable to use colored crayons, the most useful colors being green, red and yellow. A little cheap, dry paint mixed with the chalk will give the desired tints.

Crayons which are not too hard to make a good clear mark, are very apt to be brittle and unable to stand any pressure on the point when they are of sufficient length to be handled easily. If the crayons are made true cylinders, they may be covered with paper, which will serve the same purpose as the wood in the common lead pencil, and may be cut away as wanted. The common crayons, being conical, are not so easily covered, but may, nevertheless, be wrapped with a long, narrow slip of paper so as to be strong and durable.

Curling.

A method of finishing such metals as brass, German silver, etc., which if well done, gives a very handsome appearance to the work. The work must first be carefully finished so as to have no scratches, as these would show through the curling and destroy the effect. After the metal has been finished with fine files, emery paper, Water-of-Ayr stone, and finally the finest rotten stone applied by means of a buff, the curling is produced by means of a stick of charcoal moved in circular sweeps over the surface, which should be kept well moistened with water. After the desired effect has been produced, the metal is lacquered.

We have seen "curling" applied to surfaces of considerable extent, but in such cases the effect never seemed to us as good as in the case of very small articles. If the sweeps are large they give a coarse appearance to the work, while a large surface covered with small sweeps has a confused appearance.

Cuticle, Liquid.

Collodion, or gun cotton dissolved in sulphuric ether, has no equal as a covering for protecting burns, cuts or wounds

from the air. It soon dries, and forms a skin-like protection that adheres with great tenacity.

Etching.

Etching is the art of cutting lines in any material by means of some corrosive agent. Thus, since nitric acid dissolves copper, if we confine the action of the acid to certain lines, we can cut grooves of considerable depth in the copper, and these grooves may be used either as lines from which we may print, or as marks similar to writing. Iron, brass, steel, silver, ivory, glass, marble, and many other materials may be cut in the same way, by the action of suitable acids. As a simple and easily learned method of forming engraved plates from which to print, the art of etching is one of the most eligible for young persons. The materials required are few and simple, great freedom of outline may be secured, and the results are very pleasing.

Copper is the metal usually employed for etching drawings. It is furnished by the dealers in plates perfectly smooth and flat, and of any desired size. The surface is first coated with a wax or varnish, for which there are many recipes, the following being probably the best: Take of beeswax and asphalt, 2 parts each; Burgundy pitch and black pitch, 1 part each. Melt the wax and the pitch in an earthen vessel and add the asphalt by degrees in fine powder. Expose to heat until a drop which has been cooled, breaks by bending back and forth two or three times in the fingers.

A second, which is simpler and said to be very good, is composed of asphalt, 2 oz.; Burgundy pitch, 1 oz.; beeswax, 1½ oz.

A transparent varnish may be composed of resin, 1 oz.; beeswax, 2 oz. Melt together.

The plate having been polished and burnished, is grasped by one corner in a hand-vice and warmed over a spirit lamp until it will melt the varnish or etching ground, which is then spread over its surface very thinly by means of a ball or pledget of cotton tied in a piece of silk. Before the ground has quite cooled and solidified, it is blackened by the smoke of a lamp or candle. The blackening is necessary so that the design may be clearly seen as it is drawn in.

The design may be either drawn directly on the plate, or transferred by means of transfer paper. Or it may be first drawn on the etching ground by means of a very finely

pointed camel-hair pencil, using, of course, a white color dissolved in some medium which will adhere to the ground. Water is useless. Turpentine answers very well.

In whatever way the design is drawn on the surface of the ground, it must next be cut in by means of a steel point, good sewing needles making excellent ones, and different sizes being used according to the strength of the lines required. The lines having been traced through the varnish so as to expose a bright copper surface, the next step is to make a border of wax around the plate so that the acid will not run off. The wax used for making the border is a mixture of beeswax, resin and tallow, of such a consistency that it will be easily moulded by the fingers. The border should be nearly half an inch high, thus converting the plate into a shallow dish. This dish is half filled with a mixture of one part of nitric acid and three parts of water. After this plate has been exposed for a few minutes to this liquid, the acid is poured off, the plate washed with pure water and allowed to dry. All the very delicate lines are then "stopped" out, as it is called, by being coated by means of a camel-hair pencil with varnish dissolved in turpentine. When this has dried, the acid is poured back again and allowed to act on the coarser lines, and the more frequently this process is introduced, the more perfect will be the ultimate result.

When the lines have all been etched to the required depth, the varnish is removed by warming the plate and washing with turpentine. A copper-plate press is used to take off the impressions.

The process of etching is very simple, and the results very satisfactory. As an artistic recreation, it is capable of affording a great deal of pleasure.

The art of cutting names, etc., on steel tools and other objects, is very simple and useful. The following gives good results:

Etching Liquid for Steel.—Mix 1 oz. sulphate of copper, ¼ oz. of alum, and ½ a teaspoonful of salt reduced to powder, with 1 gill of vinegar and 20 drops of nitric acid. This liquid may be used either for eating deeply into the metal or for imparting a beautiful frosted appearance to the surface, according to the time it is allowed to act. Cover the parts you wish to protect from its influence with beeswax, tallow, or some similar substance.

Etching on Glass.—Fancy work, ornamental figures, lettering and monograms, are most easily and neatly cut into glass by the sand blast process, a simple apparatus for which will be found described in the *Young Scientist.* Lines and figures on tubes, jars, etc., may be deeply etched by smearing the surface of the glass with beeswax, drawing the lines with a steel point, and exposing the glass to the fumes of hydrofluoric acid. This acid is obtained by putting powdered fluorspar into a tray made of sheet lead and pouring sulphuric acid on it, after which the tray is slightly warmed.

The proportions will, of course, vary with the purity of the materials used, fluorspar (except when in crystals) being generally mixed with a large quantity of other matter, but this point need not affect the success of the operation. Enough acid to make a thin paste with the powdered spar will be about right. Where a lead tray is not at hand, the powdered spar may be poured on the glass, and the acid poured on it and left for some time. As a general rule, the marks are opaque, but sometimes they are transparent. In this case, cut them deeply and fill up with black varnish, if they are required to be very plain, as in the case of graduated vessels.

Liquid hydrofluoric acid has been recommended for etching, but as it leaves the surface on which it acts *transparent,* it is not suitable.

The agent which corrodes the glass is a gas which does not *remain* in the mixture of fluorspar and sulphuric acid, but passes off in the vapor. To mix fluorspar and sulphuric acid and keep it in leaden bottles under the idea that the mixture is *hydrofluoric acid,* is a gross mistake. Such an idea could enter into the head of none but the compiler of a cyclopaedia of recipes.

Eye, Accidents to.

Those who are engaged in mechanical operations run great risk of accidents to the eye, and therefore a few hints in regard to this subject may be valuable to our readers.

Minute particles of dust, sand, cinders, small flies, etc., are best removed by means of a camel-hair brush or pencil, moistened but not wet, and drawn to a fine point. The brush will absorb the moisture of the eye and with it will take up the mote, provided the latter has not been driven into the eyeball. Where a brush is not at hand, a thin strip of soft

paper, rolled spirally so as to form a fine point, is the best thing.

The ragged chips and splinters which are separated during the processes of turning and chipping off, often find their way into the eye, and are sometimes very difficult to remove. The use of magnets has been recommended, but even the strongest magnet is entirely inefficient, if the splinters be imbedded. In such a case, if the operator be gifted with a steady hand and firm nerves, the best instrument for removing the offending particle is a good, sharp pen-knife. Indeed, we prefer it in every case as being far superior to softer articles. In simple cases let the patient stand up with his head firmly held against a door-post; turn back the eyelids with the fingers; find the speck, and by passing the knife gently but firmly over the ball, you may sweep it up. Where the splinter is actually imbedded in the eye, lay the patient on his back on a table; turn the eyelids back, and fix them by means of a ring, and then you will find yourself free to operate without danger of interference from the patient's winking. A suitable ring may be found in most bunches of keys, or any mechanic can make one in two minutes out of a piece of stiff iron wire. Iron splinters always have ragged edges, and can be caught on the fine, sharp edge of a knife and lifted out. But although we recommend the use of a sharp knife, it must be remembered that no cutting of the eyeball is to be permitted in any case, except by an experienced occulist.

Where the person who is operating is at all nervous or timid, it will not do to use a knife. In this case, take some soft, white silk waste and wind it round a splinter of wood so as to completely cover the end and form a little brush of looped threads. Tie it fast. When such a brush is swept over that part of the eyeball where the offending substance is imbedded, the latter will soon be entangled in the threads and may be easily drawn out.

In all such cases a good magnifier will be found of great assistance. The best form is perhaps a good watchmaker's glass.

When corrosive chemicals, such as oil of vitriol, nitric acid, corrosive salts, etc., find their way into the eye, the best application is abundance of pure cold water. The eye should be *held* open and well washed out. When any irritating sub-

stance gets into the eye, the lid is apt to close spasmodically, and if allowed to remain so, no water can get in.

In the case of lime, however, the action of water would only increase the difficulty. A little vinegar and water forms the best wash for lime, potash, soda, or ammonia.

Fires.

Most of the fires that occur might be avoided by proper care, and the following hints, if carefully observed, will aid materially in avoiding such accidents:

1. Never leave matches where they can be reached by children, and if one should fall on the floor, be careful and search for it until you find it. A match, when trodden on, readily ignites, and if unobserved may cause a serious fire, or what is more likely, set a lady's dress in flames. Rats and mice have a great fondness for matches, and often carry them off to their holes, where, by nibbling, they set them on fire. Always keep matches in tin boxes, and never in paper packages.

2. Children should be strictly prevented from playing with fire, and severely punished if caught so offending. It is far better that they should undergo the inconvenience of a little wholesome chastisement than either set the house on fire, disfigure themselves for life, or be burnt to death, from the want of being severely punished for disobedience.

3. Never leave a lamp or candle burning at your bedside on a table when you go to bed, and avoid reading in bed; this is a most fruitful cause of loss of life and property.

4. If a piece of paper is used to light a lamp, see that it is properly extinguished before leaving it, as it will sometimes burst out on fire after it is supposed to have been completely extinguished.

5. If there be an escape of gas, so that the smell of it is very apparent, open the door and windows immediately to allow its escape, and facilitate the entrance of fresh air; and above all things avoid coming any way near with a light of any description. As soon as you can, shut off the gas at the meter.

6. Be careful about stove-pipes passing through lath partitions; about kindling wood left in the oven over night to dry, and about the ash-box. Never keep ashes in a wooden vessel under any circumstances whatever, and never go to

bed at night without seeing that every possible cause for an accidental fire has been removed. Allow no linen or cotton clothes to hang near a stove over night for the purpose of drying them.

7. There never yet was a fire which a single pail of water, if applied in time, would not have quenched, therefore never go to bed without having a few pails of water at hand, and a dipper with which to throw it on the fire. Water can never be so well applied if thrown from the pail itself. Spontaneous combustion is no imaginary danger, therefore never leave heaps of oiled rags and similar rubbish lying around.

As most of us are liable to be caught in a burning building, it would be well for us to impress the following hints upon the mind, as they may stand us in good stead if a fire should occur:

1. Every householder should make each person in his house acquainted with the best means of escape, whether the fire breaks out at the top or at the bottom. In securing the street door and lower windows for the night, avoid complicated fastenings or impediments to an immediate outlet in case of fire.

2. Inmates, at the first alarm, should endeavor to reflect what means of escape there are in the house; if in bed at the time, wrap themselves in a blanket or bedside carpet; open neither windows nor doors more than necessary; shut every door after them. This is most important to observe.

3. In the midst of smoke it is comparatively clear toward the ground, consequently progress through the smoke can be made on the hands and knees. A silk handkerchief, worsted stockings, or other flannel substance wetted and drawn over the face, permits free breathing, and excludes, to a great extent, the smoke from the lungs. A wet sponge is alike efficacious.

4. In the event of being unable to escape, either by the street door or roof, the persons in danger should immediately make their way to a front room window, taking care to close the door after them, and those who have charge of the household should ascertain that every individual is there assembled.

5. Persons thus circumstanced should never precipitate themselves from the windows while there remains the least probability of assistance; and even in the last extremity a plain rope is invaluable, or recourse may be had to joining

sheets or blankets together, fastening one end round the bed-post or other furniture. This will enable one person to lower all the others separately, and the last may let himself down with comparatively little risk. Select a window over the doorway rather than over the area.

Clothes on Fire.—So many accidents are daily occurring from broken kerosene lamps, and clothes taking fire from gas lights and open fire-places, that it is very important to know what to do under such circumstances. Three persons out of four would rush right up to the burning individual, and begin to paw with their hands without any aim. It is useless to tell the victim to do this or that, or call for water. In fact it is generally best not to say a word, but seize a blanket from a bed, or a cloak, or any woolen fabric—if none is at hand, take any heavy material—hold the corners as far apart as you can, stretch them higher than your head, and running boldly to the person, make a motion of clasping in the arms, just about the shoulders. This instantly smothers the fire and saves the face. The next instant throw the unfortunate person on the floor. This is an additional safety to the face and breath, and any remnant of flame can be put out more leisurely. When the person whose clothes take fire is alone, the danger is not unfrequently increased by the sufferer running about in a state of alarm; whereas it would be better for him to roll on the floor until the fire is extinguished, or better still, to cover himself with a loose carpet, rug, or blanket, to exclude the air, till a sufficient supply of water is obtained to throw over him. In either case, after the fire has been put out, the individual should be placed on a bed, and the clothes removed piecemeal by cutting them off; much caution is required in taking away the body linen without tearing off the skin, and where the linen sticks, so much only should be cut off as can be detached readily.

Fire Proof Dresses.—Some years ago Queen Victoria appointed a commission to investigate this subject. It was found that there were but four salts which were applicable to light fabrics: 1, Phosphate of ammonia; 2, a mixture of phosphate of ammonia and chloride of ammonia; 3, sulphate of ammonia; 4, tungstate of soda. Of these, the best was tungstate of soda, a salt which is not by any means expensive. Sulphate of ammonia is objectionable, from the fact that it acts on the irons and moulds the fabric. The tungstate of

soda is neither injurious to the texture or color, or in any degree difficult of application in the washing process. The iron passes over the material quite as smoothly as if no solution had been employed. The solution increases the stiffness of the fabric, and its protecting power against fire is perfect. This salt offers only one difficulty, viz: the formation of a bitungstate, of little solubility, which crystallizes from the solution; but it was found that a very small percentage of phosphate of soda rendered the tungstate quite stable. The best method of applying these salts is to take one ounce of tungstate of soda and a quarter of an ounce of phosphate of soda, and dissolve them in a quart of water. The goods are moistened with this solution before being starched, and they may be afterwards ironed and finished without the least difficulty.

Articles prepared in this way are perfectly uninflammable. They may be charred by exposure to fire, but they do not burn readily unless there is some extraneous source of heat, and they can not be made to burst into flame. By the aid of this discovery, a lady dressed in the lightest muslin might walk over a row of footlights, and the only result would be that the lower part of her dress would be injured. Unless her person actually came in contact with the gas flames, she herself would suffer no injury. In country places, where tungstate of soda cannot be procured, a mixture of three parts borax, and two and a half parts sulphate of magnesia, in twenty parts of water, may be used with good effect.

Fly-Papers.

Sticky or adhesive fly-papers are to be discouraged, as it is a cruelty to subject even flies to the long struggles and slow death caused by it. Such papers, however, are occasionally sold, and are prepared by coating paper with factitious bird-lime. Or the bird-lime is smeared upon wooden sticks standing in a base, for instance, a flower-pot, when they will adhere to it. A better plan is to mix some poison with the adhesive mass, but care should be taken lest children get at it. Cooley gives the following formula: Treacle, honey, or moist sugar mixed with about 1-12th of their weight of orpiment (yellow tersulphide of arsenic). Redwood's formula is: Small quassia chips, ¼ oz.; water, 1 pint; boil 10 minutes, strain, and add 4 oz. of treacle. Flies will drink this with avidity, and are soon destroyed by it.

Freezing Mixtures.

The temperatures here given are Fahrenheit. When ice or snow are not to be had and it is desired to cool any solid, liquid or gas, a good freezing mixture is the simplest method of accomplishing the object. The following mixtures are the most convenient and efficient:

1. Nitrate of ammonia, carbonate of soda and water, equal parts by weight. The thermometer sinks 57°.

2. Phosphate of soda, 9 parts; nitrate of ammonia, 6 parts; diluted nitric acid, (acid 1 part, water 2 parts,) 4 parts. Reduces the temperature 71° or from 50° to — 21°.

3. Sal ammoniac, 5 parts; nitrate of potash, 5 parts; sulphate of soda, 8 parts; water, 16 parts. Reduces the temperature 46° or from 70° to 24°. This is one of the cheapest, most readily procured, and most convenient of mixtures.

Freezing mixtures are often used when it is required to produce a greater degree of cold than can be obtained by the mere application of ice. When ice is at hand, as it generally is in this country, the following should be used:

1. Finely pounded ice, 2 parts; salt, 1 part. This mixture reduces the temperature to 5°.

2. Finely pounded ice, 2 parts; crystallized chloride of calcium, 3 parts. Reduces the temperature from 32° to — 40°.

3. Finely pounded ice, 7 parts; diluted nitric acid, 4 parts. Reduces the temperature from 32° to — 30°.

In every case the materials should be kept as cool as possible. Thus the ice should be pounded in a cooled mortar with a cooled pestle, and the mixture should be made in vessels previously cooled. By attention to these particulars it is easy to freeze mercury at any time by means of these simple and easily practiced methods, though, of course, the modern laboratory is provided with agencies of far greater cooling power.

Fumigating Pastils.

For the purpose of deodorizing a room in which there is an offensive smell, common coffee berries, and even rags or brown paper, if properly burned, will serve admirably. The smoke from these substances not only neutralizes the odors, but really acts as a disinfectant to a slight extent. In burning coffee, paper or rags for this purpose, care must be taken to prevent them from burning too freely. If they burn with

a free, bright flame, the proper effect will not be produced. They should be allowed to smoulder quietly, and they do this best when they are thrown on hot coals, or a hot shovel and set on fire.

An excellent substitute for pastils is heavy brown paper, which has been dipped in a solution of nitre and then dried. This burns freely without flame, and if it be dipped in a solution of benzoin, the odor is very pleasant. The best thing, however, is pastils. They are easily made as follows:

1. *Paris Formula.*—Benzoin, 2 oz.; balsam of tolu and yellow sandal wood, of each 4 drachms; nitre, 2 drachms; labdanum, 1 drachm; charcoal, 6 oz. Reduce to powder, mix thoroughly and make into a stiff paste with gum tragacanth. Form into small cones and dry them in the air.

2. *Formula of Henry and Guibourt.*—Powdered benzoin, 16 parts; balsam of tolu and powdered sandal wood, each 4 parts; charcoal powder, 48 parts; powdered tragacanth and labdanum, each 1 part; powdered nitre and gum arabic, each 2 parts; make into a paste with 12 parts cinnamon water, form into cones and dry.

3. The following formula is somewhat complex, but gives very fine results: Take the charcoal of any light wood, 200 parts; gum benzoin, 100 parts; powdered sandal wood, 50 parts; balsam of tolu, 50 parts; Storax (Styrax calamita), 50 parts; gum olibanum, 50 parts; cascarilla bark, 100 parts; cloves, 40 parts; cinnamon (Ceylon), 40 parts; potassium nitrate, 75 parts. Reduce the ingredients to powder, and mix them with oil of Ceylon cinnamon, 5 parts; oil of cloves, 5 parts; oil of lavender, 5 parts; balsam of Peru, 10 parts; camphor, powdered, 1 part. Then add mucilage of tragacanth sufficient to make a mass which is to be formed into conical cylinders about ¾ to 1 inch high, and ending at the bottom in three projections. Dry them in a warm place.

Gilding.

A covering of gold, when judiciously applied to the proper parts of any object adds greatly to its beauty, and in the case of metals, such as steel, copper, silver, etc., the gold, being capable of resisting the action of most chemical agents, proves a very perfect protector against corrosion. Metals are now generally gilt by means of the electrotype process, though the old method by means of an amalgam, is still used in some

cases. Stamped goods, such as cheap jewelry, are also made out of sheets of metal which, after being heavily gilt, are rolled out thin, the gold being thus spread over an astonishing extent of surface. For gilding leather, wood, etc., gold in the form of leaf or powder is generally used.

Gilding with Gold-Leaf.—There are various methods applicable, according to the different circumstances and the character of the objects to be gilded. Book-binders use gold-leaf in two ways—to gild on the edge, and to place gold letters on the binding. To gild on the edge, the edge is smoothly cut, put in a strong press, scraped so as to make it solid, and the well-beaten white of an egg or albumen put on thinly; the gold-leaf is then put on before the albumen is dry; it is pressed down with cotton, and when dry polished with an agate polisher. To put on the lettering, the place where the letters are to appear is coated with albumen, and after it is dry, the type to be used is heated to about the boiling point of water, the gold-leaf put on, either on the book or on the type, and then placed on the spot where the lettering is desired, when the gold-leaf will adhere by the heat of the type, while the excess of gold-leaf loosely around is rubbed off with a tuft of cotton.

To do printing with gold-leaf, the sheet to be printed on is pinned to the tympan of a hand-press, and it is first printed with ink of any color, or with varnish, and then the type is covered with a large sheet of paper, the gold-leaf laid on, and the tympan laid down again, slowly and carefully, so as not to disturb the gold-leaf by motions of the air; then the pressure is again applied, when the gold-leaf will stick to the printed sheet, and the surplus can be rubbed off with a tuft of cotton. Ordinary printing in gold, silver and bronze, however, is done with powdered metal and not with leaf. The printing is first done with a varnish specially made for the purpose; after the impression has been taken, the sheets are allowed to lie a short time so as to dry a little, but not completely, and while still *tacky* the gold, silver or bronze powder is sprinkled over the letters. The powder adheres to the varnish, and the surplus is easily removed by means of a tuft of cotton.

In gilding picture-frames with gold-leaf there are two methods; one with the ordinary gold size, the other with varnish. The latter method does not allow polishing, but is

water-proof; the former is not. The main point is to have a well prepared ground-work of say white lead and drying oil, smoothed down properly; then follow several coats of calcined white lead in linseed oil and turpentine, with intervals of at least twenty-four hours between each coat, which must be carefully smoothed off with pumice-stone and fine emery-paper. Then the gold size is applied, which may be made from the sediment that collects at the bottom of the pot in which painters wash their brushes; this is thoroughly ground and strained. When the gold size coat is sufficiently dry so as to be a little sticky, apply the gold-leaf and press it on with cotton or a soft brush; after a few days' hardening it is varnished with spirits or oil varnish. This gives a water-proof gilding, but ordinarily picture-frames are gilded with a gold size containing no oil. It is made of finely ground sal ammoniac, to which is added a very little beef suet; this is mixed with a pallet-knife, with parchment size dissolved in water, so as to flow from the knife when hot. The frame may be prepared first with a few coats of Paris white and glue-water, rubbed down smoothly, and finally apply the size, which must not be too thick, as then it will chip off, and if too thin it will not have sufficient body. The most difficult part in all these operations of gold-leaf gilding, is the application of the gold-leaf, which requires much practice, judgment, and great care, but with some attention to little details it can be easily learned. There ought to be no draught at the place of operation and the operator ought to avoid allowing his breath to blow upon the gold leaves, as they are so thin and light that the least breath of air causes them to fly about—worse than feathers. Turn the gold leaves—one at a time—out of the book upon the leather cushion; with the gilding-knife you may lift any leaf and carry it to a convenient place to cut it into the sizes required. Blow gently on the center of the leaf, and it will at once spread out and lie flat without any wrinkles, then cut it by passing the edge of the knife over it until divided. Place the work to be gilded as near as practicable in a horizontal position, and with a long camels'-hair pencil, dipped in a mixture of water with a little brandy, go over as much surface as the piece of gold is to cover; then take up the gold from the cushion with a tip. Drawing it over the forehead and cheek will dampen it sufficiently to make the gold adhere. This must then be carefully trans-

ferred to its place on the work, and by gently breathing on it, it will adhere. Take care that the part to which it is applied be sufficiently wet, so that the gold-leaf will not crack. Proceed in this way, a little at a time, not attempting to cover too much at once. If any cracks or flaws appear, immediately apply another piece of gold-leaf over it—large enough to cover the crack. If occasionally the gold does not appear to adhere, on account of the ground having become too dry, run a wet pencil close to the edge of the gold, so as to allow water to penetrate under the gold-leaf. When the work is dry (say in ten or twelve hours), it may be burnished with an agate tool, taking care to first remove all the dust from the tool as well as from the gilded surface.

Ornamental lines of gilding may be painted on wood and other articles by means of a fine camel-hair brush, using shell gold, which may be had at the artists' supply stores. This forms a very good method of ornamenting work done by the scroll saw, or carved work, such as frames, etc.

Gilding Steel.—Polished steel may be beautifully gilded by means of the ethereal solution of gold. Dissolve pure gold in aqua regia, evaporate gently to dryness, so as to drive off the superfluous acid, re-dissolve in water and add three times its bulk of sulphuric ether. Allow to stand for twenty-four hours in a stoppered bottle and the ethereal solution of gold will float at top. Polished steel dipped in this is at once beautifully gilded, and by tracing patterns on the surface of the metal with any kind of varnish, beautiful devices in plain metal and gilt will be produced. For other metals the electro process is the best.

Glass Working.

Glass is usually brought into shape by being moulded or blown. Simple and complete directions for blowing small articles may be found in the *Young Scientist*, vol. I, p. 37.

There are a few other operations, however, which are constantly needed by the amateur and which we will describe.

Cutting Glass.—For cutting flat glass, such as window-panes, and for cutting rounds or ovals out of flat glass, the diamond is the best tool; and, if the operator has no diamond it will always pay to carry the job to a glazier rather than waste time and make a poor job by other and inferior means. When, however, it is required to cut off a very little from a

circle or oval, the diamond is not available, except in very skilful hands. In this case a pair of pliers softened by heating, or very dull scissors is the best tool, and the cutting is best performed under water. A little practice will enable the operator to shape a small round or oval with great rapidity, ease and precision. When bottles or flasks are to be cut, the diamond is still the best tool in skilful hands; but ordinary operators will succeed best with pastils, or a red hot poker with a pointed end. We prefer the latter, as being the most easily obtained and the most efficient; and we have never found any difficulty in cutting off broken flasks so as to make dishes, or to carry a cut spirally round a long bottle so as to cut it into the form of a corkscrew. And, by the way, when so cut, glass exhibits considerable elasticity, and the spiral may be elongated like a ringlet. The process is very simple. The line of the cut should be marked by chalk or by pasting a thin strip of paper alongside of it; then make a file mark to commence the cut; apply the hot iron and a crack will start; and this crack will follow the iron wherever we choose to lead it. In this way jars are easily made out of old bottles, and broken vessels of different kinds may be cut up into new forms. Flat glass may also be cut into the most intricate and elegant forms. The red hot iron is far superior to strings wet with turpentine, friction, etc.

Drilling Glass.—For drilling holes in glass, a common steel drill, well made and well tempered, is the best tool. The steel should be forged at a low temperature, so as to be sure not to burn it, and then tempered as hard as possible in a bath of salt water that has been well boiled. Such a drill will go through glass very rapidly if kept well moistened with turpentine in which some camphor has been dissolved. Dilute sulphuric acid is equally good, if not better. It is stated, that at Berlin, glass castings for pump-barrels, etc., are drilled, planed and bored, like iron ones, and in the same lathes and machines, by the aid of sulphuric acid. A little practice with these different plans will enable the operator to cut and work glass as easily as brass or iron.

Turning Glass in the Lathe.—Black diamonds are now so easily procured that they are the best tools for turning, planing or boring glass where much work is to be done. With a good diamond a skilful worker can turn a lens roughly

out of a piece of flat glass in a few seconds, so that it will be very near the right shape.

A splinter of diamond may be very readily fastened in the end of a piece of stout brass wire so that it may be used for drilling or turning glass. Bore a hole the size of the splinter and so deep that the diamond may be inserted beyond its largest part, but leaving the point projecting. Then, by means of a pair of stout pliers, it is easy to press the end of the brass so that it will fill in around the diamond and hold it tight. Diamonds are sometimes cemented in such holes by means of shellac, or even solder run around them. This answers for some purposes, but not for drilling or turning.

Fitting Glass Stoppers.—Very few stoppers fit properly the bottles for which they are intended. The stoppers and bottles are ground with copper cones, fed with sand and made to revolve rapidly in a lathe, and the common stock are not specially fitted. To fit a stopper to a bottle that has not been ground, use emery or coarse sand kept constantly wet with water, and replaced with fresh as fast as it is reduced to powder. When all the surface has become equally rough, it is considered a sign that the glass has been ground to the proper shape, as until that time the projecting parts only show traces of erosion. This is the longest and hardest part of the work, as after that the glass simply needs finishing and polishing. For that purpose emery only can be used, owing to the fact that the material can be obtained of any degree of fineness, in this respect differing from sand. Otherwise the operation is the same as before, the emery being always kept moistened, and replaced when worn out. The grinding is continued until both the neck of the bottle and the stopper acquire a uniform finish, of a moderate degree of smoothness, and until the stopper fits so accurately that no shake can be felt in it, even though it be not twisted in tightly.

Glass Stoppers.—To remove glass stoppers when tightly fixed, it has been recommended to apply a cloth wet in hot water. This is an inconvenient and frequently unsuccessful method. The great object is to expand the neck of the bottle so as to loosen it on the stopper. If, however, the latter be heated and expanded equally with the former, the desired effect is not produced; and this is often the case in applying hot water. By holding the neck of the bottle about

half an inch above the flame of a lamp or candle, for a few seconds, we have never failed in the most obstinate cases. The hands should be wrapped in a towel, and great care should be taken not to let the flame touch the glass, as this might cause it to crack. The bottle should be kept rapidly turning, during the operation, so as to bring all parts of the neck equally under the influence of the heat, when it will be rapidly expanded and the stopper may be withdrawn by a *steady* pull and twist. Sometimes it is necessary to tap the stopper lightly with a piece of wood; the jar is very apt to loosen the stopper. To twist the stopper, make, in a piece of wood, an oblong hole into which the stopper will just fit.

Glass, To Powder.—Powdered glass is frequently used instead of paper, cloth, cotton or sand for filtering varnishes, acids, etc. It is not soluble or corrodible. Sand, if purely silicious, would be better, but such sand is difficult to get; it too often contains matters which are easily corroded or dissolved. Powdered glass when glued to paper is also used for polishing wood and other materials. It cuts rapidly and cleanly, and is better than sand for most purposes. Glass is easily pulverized after being heated red hot and plunged into cold water. It cracks in every direction, becomes hard and brittle, and breaks with keenly cutting edges. After being pounded in a mortar it may be divided into powders of different degrees of fineness by being sifted through lawn sieves.

Glass, Imitation Ground—Put a piece of putty in muslin, twist the fabric tight, and tie it into the shape of a pad; well clean the glass first, and then putty it all over. The putty will exude sufficiently through the muslin to render the stain opaque. Let it dry hard, and then varnish. If a pattern is required, cut it out in paper as a stencil; place it so as not to slip, and proceed as above, removing the stencil when finished. If there should be any objection to the existence of the clear spaces, cover with slightly opaque varnish. In this way very neat and cheap signs may be painted on glass doors.

Glass Ware, Packing.—Every one has this duty to perform occasionally, and it is well to know how it should be done. The safety of glass articles packed together in a box does not depend so much upon the quantity of packing material used, as upon the fact that no two pieces of glass come into actual contact. In packing plates, a single straw placed between

two of them will prevent them from breaking each other. In packing bottles in a case, such as the collecting case of the microscopist, and the test case of the chemist, rubber rings slipped over each, will be found the best and handiest packing material. They have this great advantage that they do not give rise to dust.

Washing Glass Vessels.—In many operations where glass vessels are used, success will depend upon having the glass perfectly clean. Upon this subject a correspondent of the *Chemical News* says: Such a subject may seem too simple, but yet the more I see students at their work, the more I am impressed with the fact that but few know how to wash a beaker-glass clean. Some time since I took beakers from various students in my laboratory (which they had washed and put away), and held them under a powerful stream of water until they were thoroughly wet. On taking them from under the spout, in almost every case the water ran off the glass in spots, showing that the glass was greasy. The best thing to wash beakers, etc., with, according to my experience, is sand-soap. Naturally, the sand must not be sharp. The soaps containing infusorial earth are most excellent for this purpose. Borax soap is also very efficacious. A piece of board about 20 cm. long, 15 cm. wide, and 4 cm. thick, should be screwed on to the right (inside) of the sink. In this block a rectangular hole, about 2 cm. deep and 1 cm. smaller than the section of the soap when stood on its long end, is to be cut. The bottom of the cake of soap is then whittled away so that it fits tightly in the hole. It is now moistened and pushed into the aperture, where it remains tightly fixed. By wetting the right hand thoroughly, and rubbing on this soap ridge, a good lather is made. With the soapy hand the glass is rubbed and washed until, on taking it from under the stream, no oily spots appear, the glass appearing wet all over. The beaker is then dried with a good towel ("glass towel"), and finally polished with a piece of chamois or kid leather. The final polish with kid is necessary, since the best towel leaves fibres on the glass. In cleaning test tubes, it is only necessary to rub the probang on the soap.

For cleaning flasks and bottles which have been soiled with varnishes or resins, or for cleaning the glass slides used for microscopic objects, proceed as follows: Remove all the balsam, resin, varnish, etc., possible by means of heat,

scraping, and a solution of soda or potash. When the article is as clean as possible, place it in strong sulphuric acid, to which must be added as much powdered bichromate of potassa.

The chromic acid will quickly destroy all organic matter, and the article when washed in pure water will be found perfectly clean.

Grass.

Grass, To Stain Dried.—There are few prettier ornaments, and none more economical and lasting, than bouquets of dried grasses mingled with the various unchangeable flowers. They have but one fault, and that is this, the want of other colors besides yellow and drab or brown. To vary their shade artificially, these flowers are sometimes dyed green. This, however, is in bad taste and unnatural. The best effect is produced by blending rose and red tints together, and with a very little pale blue with the grasses and flowers as they dry naturally. The best means of dyeing dried leaves, flowers and grasses, is to dip them into the alcoholic solution of the various compounds of aniline. Some of these have a beautiful rose shade; others red, blue, orange and purple. The depth of color can be regulated by diluting, if necessary, the original dyes, with alcohol, down to the shade desired. When taken out of the dye, they should be exposed to the air to dry off the alcohol. They then require arranging or setting into form, as, when wet, the petals and fine filaments have a tendency to cling together. A pink saucer, as sold by most druggists, will supply enough rose dye for two ordinary bouquets. The pink saucer yields the best rose dye by washing it off with water and lemon juice. The aniline dyes yield the best violet, mauve and purple colors.

Guns.

The excellence of a gun depends very much upon the form and finish of the interior of the barrels, and as the owner may, if he chooses, work the inside of his gun over so as to improve it, we give a few directions.

Freeing.—It has been found that a perfect cylindrical tube is not the best form for a gun barrel. Guns shoot most closely and strongly when the bore is *very slightly* enlarged towards the muzzle. This enlargement is easily effected by means of very fine emery paper wrapped about a round rod

and used with a little oil. The freeing may extend to about one-third of the length of the barrel, and the gun should be tested from time to time during the process, so as to get the very best results. The testing is done by firing a standard charge of powder and shot at a sheet of brown paper and noting the number of pellets that are put into a circle of given size, and also the force with which they are driven into a board. For ordinary bird guns, a 30-inch circle at forty yards, makes a good target.

To Keep Barrels from Rusting.—One of the great difficulties which the sportsman has to contend against is the rusting of his barrels, even when protected by the best browning. The alkaline matter existing in snow and in rain, under certain conditions of the atmosphere, works through the best coatings, and reaches the iron. Varnish, as ordinarily laid on, is objectionable, as it gives a gun a "Brummagem" look. The best plan is the following: Heat the barrels to the temperature of boiling water (not any hotter, or you may injure them), and rub them with the best copal varnish, giving them a plentiful coating. Let them remain hot for half an hour, and then wipe them clean with a soft rag. In this way you can get enough of the varnish into the pores of the metal to act as a preservative, and, at the same time, no one would suspect that the barrels had ever been touched with varnish. We have applied boiled oil, beeswax, paraffin, and some other substances, in the same way, and obtained good results; but on the whole, we find nothing better than good copal varnish.

Browning Gun Barrels.—To obtain a handsomely browned barrel, we must not only use a first rate recipe, but we must apply a good deal of skill and no small amount of hard work. When barrels are imperfectly browned, the fault lies more frequently in defective work than in the use of a poor recipe.

The following are the directions given in the United States Ordnance Manual, and it is to be presumed that these are the directions that are followed in the government armories.

Materials for Browning Mixture.—Spirits of wine, 1½ oz.; tincture of steel, 1½ oz.; corrosive sublimate, 1½ oz.; sweet spirits of nitre, 1½ oz.; blue vitriol, 1 oz.; nitric acid, ¾ oz. To be mixed and dissolved in one quart of warm water, the mixture to be kept in glass bottles and not in earthen jugs.

Previous to commencing the operation of browning, it is necessary that the barrel or other part should be made quite bright with emery or a fine smooth file (but not burnished), after which it must be carefully cleaned from all greasiness; a small quantity of powdered lime rubbed well over every part of the barrel, is the best for this purpose, but in the case of old work, which is very oily or greasy, or when the oil or grease has become dried or gummed on the surface, the barrels must be first washed with a strong solution of potash in warm water. After this the lime may be applied. Plugs of wood are then to be put into the muzzle of the barrel and into the vent, and the mixture applied to every part with a clean sponge or rag. The barrel is then to be exposed to the air for twenty-four hours, after which time it is to be well rubbed over with a steel *scratch-card* or *scratch-brush*, until the rust is entirely removed; the mixture may then be applied again, as before, and in a few hours the barrel will be sufficiently corroded for the operation of scratch-brushing to be repeated. The same process of scratching off the rust and applying the mixture is to be repeated twice or three times a day for four or five days, by which time the barrel will be of a very dark brown color.

When the barrel is sufficiently brown, and the rust has been carefully removed from every part, about a quart of boiling water should be poured over every part of the barrel, in order that the action of the acid mixture upon the barrel may be destroyed, and the rust thereby prevented from rising again.

The barrel, when cold, should afterwards be rubbed over with linseed oil or sperm oil. It is particularly directed that the steel scratch-card or scratch-brush be used in the place of a hard hair-brush, otherwise the browning will not be durable nor have a good appearance.

If the work be handled with unclean or greasy hands, imperfectly browned places will show where the hands have touched the barrels.

Varnish for Browned Iron.—Shellac, 1 oz.; dragon's blood, 3-16ths of an oz.; alcohol, 1 quart.

Very complete directions for browning gun-barrels may be found in a little book called "Shooting on the Wing," which may be obtained from the publishers of this volume.

Handles, To Fasten.

The handles of knives, forks, and similar articles, that have come off by being put in hot water, may be fastened on in the following manner:

1. Take powdered resin and mix with it a small quantity of powdered chalk, whiting or slaked lime. Fill the hole in the handle with the mixture, heat the tang of the knife or fork and thrust in. When cold it will be securely fastened.

2. Take one lb. resin and 8 oz. sulphur, melt together, form into bars, or when cold reduce to powder. One part of the powder is to be mixed with half a part of iron filings, brick dust or fine sand; fill the cavity of the handle with the mixture and insert the tang, previously heated.

3. Brick dust and powdered resin, make a very good composition. It may be melted and poured into the handle, or powdered and then put in, and the tang inserted warm.

4. Chopped hair, flax, hemp or tow, mixed with powdered resin and applied as above.

5. One pound colophony, 8 oz. sulphur; melt, and when cool reduce to powder. Mix with this some fine sand or brick dust, and use as stated.

6. Take a portion of a quill, put it into the handle, warm the tang and insert it into the quill in the handle, and press it firmly. This is a simple method, and answers the purpose required very well.

Ink.

The varieties of writing-fluids that have been devised and introduced are almost innumerable, but for practical purposes the inks in common use may be divided into three classes, viz: 1. Those which consist of a powder mechanically divided and suspended in water by means of mucilage. 2. Those which consist of chemical precipitates held in suspension in the same way. 3. Those which consist of a true solution of some coloring matter, such as aniline or carmine. Of the first class, Indian or China ink is the great type. It consists of carbon in the form of very fine lamp-black, ground to a state of impalpable fineness in water, and mixed with some pure form of gelatine. Its use is wholly restricted to draughtsmen, who prefer it for several reasons. In the first place, it gives the finest and clearest black of any ink known; second, it is unchangeable; and in the third place, it does

not corrode the fine and expensive steel instruments with which it is used. A really good article of Indian ink is somewhat difficult to find. Much of the ink in market is gritty, and instead of being a fine jet black, it is of a blueish-gray color. Moreover, notwithstanding all the grinding that the artist can give it, the particles are always coarse, and it does not readily sink into the paper. With such ink it is difficult to draw fine, clear, black lines, and utterly impossible to produce a soft mellow tint in shading. It is probable that the quality of the ink depends not only upon the materials from which it is made, but upon the method pursued in its manufacture, and in regard to both these points we are as yet wholly in the dark. When good Indian ink is wanted, therefore, the only method of securing it is to test carefully the various samples, until we get a good one, and then secure a supply that will last indefinitely. Fortunately the last is not a difficult thing to do, when we have found a sample that suits us; for a single stick of Indian ink, if carefully used, will last many years, even in the hands of a professional draughtsman. Of late years a liquid Indian ink has been introduced, and has given good satisfaction, but it is scarce and expensive. Since the ordinary Indian ink is made up with a fine animal glue, instead of mucilage made of vegetable gum, it very soon decomposes when ground up with water. Hence it can not be kept in bottles like ordinary ink, but must be prepared fresh whenever it is needed. As an ink for ordinary writing it is worthless, for the simple reason that it does not flow well, though for purposes where an absolutely indelible ink is needed—as, for instance, in writing out deeds and records—nothing better can be obtained. When used for this purpose, the addition of a *very* small quantity of caustic alkali—or, what is better yet, of ox-gall—causes it to flow freely and to sink deeply into the paper or other material used to receive it, provided the latter be not too heavily sized. When properly applied, neither heat, moisture, acids, alkalies, nor chemicals of any kind, affect it; and it might therefore be properly used to write those records which are placed under the corner-stones of important buildings, and which are expected to endure for an indefinite period.

The second class of inks comprises all those black inks and writing fluids that are commonly employed for commercial correspondence and records. The different formulæ for the

preparation of ink that have been published, would fill a good sized volume; but most of the inks and writing fluids in market consist of a precipitate of gallate or tannate of iron held in suspension by means of mucilage. Since iron may be used in either one of two distinct conditions when it is employed for the manufacture of ink, it follows that two distinct kinds of ink may be made from it. In one of these the iron is fully oxidated, and the ink is of a deep jet black. The precipitate of iron which exists in such ink seems to assume a coarse and heavy form, with a strong tendency to sink to the bottom of the containing vessel. It therefore requires a large proportion of mucilage to keep the coloring matter in suspension. The advantage which it possesses, is, that the ink is, from the very first, of a deep black ; but on the other hand, the objections are quite as important, and consist in the fact that it can not be made to flow freely, and that it does not sink well into the paper, and is consequently easily removed. On the other hand, ink made with salts in which the iron exists as protoxide, is always pale at first, but afterwards assumes a dark hue; it flows freely and sinks well into the fibre, so that it is difficult to remove marks made by it. This character it is apt to lose, however, when exposed to the air, as we shall note when speaking of the preservation of ink.

In some cases a compromise is made, and the ink is prepared from materials, part of which only are in a state of complete oxidation. An attempt is thus made to secure an ink, which, while black from the first, will flow freely and sink well into the paper, and some very good inks are thus compounded.

Most of the inks known as violet, mauve, blue, red, carmine, etc., consist of true chemical solutions, generally nowadays of aniline, though the finest red ink is still made from carmine dissolved in ammonia. From the fact that there is no solid material to be kept in supension, these inks do not require mucilage in their composition provided they are used on paper that has a good deal of size in it; they consequently flow freely, do not leave a heavy streak of liquid behind the pen, and the streak that they do leave sinks almost instantly into the paper and disappears. In using them, no blotter is required; and they are, therefore, great favorites with authors and those persons who pay less regard

to the color of their writing than to the ease with which the work is done, and the clearness and unblotted appearance which it presents. But from the fact that no really good black ink of this class has yet been produced, they have not come into general use amongst book-keepers and commercial men, and it must be acknowledged that on the whole a good black ink gives a better appearance to a set of books than ink of any other color.

Ink used for copying letters by means of the press, requires to be thicker than that used for ordinary writing, and therefore it is less pleasant to use; but the great advantage which attends the mechanical process of copying letters will always keep up the demand for it.

Such being the peculiar character of the inks in common use, it may be well to say a few words concerning the best methods of preserving them in good condition. The great enemies of all inks are evaporation, dust, and decomposition, and, in the case of iron inks, oxidation. The first difficulty can only be avoided by keeping the ink from exposure to the air, and this is best effected by adopting an inkstand in which the ink exposes a very small surface to the air. Many of the inkstands in use are made large at the base, for the purpose of rendering them difficult to overturn. In such stands the ink is spread out in a thin, wide layer, and not only evaporates rapidly, but where ordinary black ink is used, the iron oxidates, and the ink consequently deteriorates. A very common practice on the part of those who use ink, is to leave the mouth of the stand uncovered, in which case the ink becomes in a short time reduced to mud. All these difficulties may be in a measure avoided by using a heavy stand, having a small well or ink-holder, which should be kept well covered when not in use, and ought to be frequently cleaned, the old ink being thrown away. The supply of ink should be kept in a bottle, securely corked, and when the stand is filled, the new ink ought never to be poured into the old, as is generally done. Throw the old ink away; wash out the stand carefully, and fill it up with new fluid, and then you can enjoy the luxury of writing with ink that flows freely, and does not take half a minute to moisten the paper at each stroke that you attempt to make. To keep ink in good order, the stand should be washed out every two or three weeks.

Many inks, especially those made with iron and galls, are liable to mould and decompose. The formation of mould may, to a certain extent, be prevented by the use of creosote, carbolic acid, or cloves, and most of the better class of inks in market are prepared so as to resist this evil.

In the recipes generally given for making ink, it is recommended to *boil* the ingredients. A much better plan is to powder the galls and macerate them in cold water. By this latter process, more time is of course necessary to make it; but then the ink is very superior, and entirely free from extractive matter which has no inky quality, and which only tends to clog the pen and to turn the ink ropy and mouldy.

Black Ink.—1. In 1 gallon of water macerate 1 lb. of finely powdered Aleppo galls for two weeks, and strain off the liquid. Dissolve 5½ oz. sulphate of iron and 5 oz. gum arabic in as little water as is necessary, and mix the two liquids with constant stirring. Keep in a tall bottle, allow it to settle for some days, and it will be ready for use.

2. Take gall nuts, broken, one pound; sulphate of iron, half a pound; gum acacia and sugar candy, of each, a quarter of a pound; water, three quarts. Place the whole of these ingredients in a vessel where they can be agitated once a day; after standing for a fortnight or three weeks the ink is ready for use. Logwood and similar materials, are often advised to be used in conjunction with the gall nuts, but they serve no good purpose unless it be to make a cheaper article which fades rapidly.

3. It is said that the juice of elderberries to which sulphate of iron has been added, makes a good ink. The best formula is said to be 12½ pints juice and ½ oz. each sulphate of iron and crude pyroligneous acid.

Runge's Black Ink.—1. The original recipe of the inventor is as follows: Digest ¼ lb. logwood in chips for 12 hours in 3 pints boiling water. Simmer down gently to 1 quart, filter and add 20 grains yellow chromate of potassa.

2. The following modification of the above is more easily prepared: Dissolve 16 parts of extract of logwood in 1,000 parts of water, and add 1 part of neutral potassium chromate (yellow chromate of potassa).

Blue Ink.—Take 6 drachms pure Prussian blue and 1 drachm oxalic acid. Grind in a mortar with a little water

until they form a perfectly smooth paste. Dissolve a sufficient quantity of this paste in water to give the proper tint.

Carmine Ink, French Process.—Take 22 grammes (4 grains) of the best carmine, add to it sixty-five grammes (2 ounces) of caustic ammonia, add one gramme (15½ grains) of white gum arabic. Leave the mixture until the gum is entirely dissolved. This ink is undoubtedly dearer than that prepared in the ordinary way, but it is incomparably more beautiful and more durable, for experience has proved that letters written with this ink, have for forty years been preserved without the slightest alteration.

Red Ink.—Boil ½ lb. of Brazil wood, ¼ oz. of gum, ½ oz. of sugar, and ½ oz. of alum in a sufficient quantity of vinegar.

Aniline Inks.—The following formulæ for aniline inks are from recent authorities, and are said to give superior results:

Alcoholic Solutions.—1. General Formula: Dissolve 15 parts of aniline color in 150 parts of strong alcohol in a vessel of glass or enamelled iron for three hours; then add 1,000 parts distilled water; heat gently for some hours,—in fact, till the odor of the alcohol has quite disappeared; then add a solution consisting of 60 parts of powdered gum arabic in 250 parts of water.

2. Special Formula for Violet: Digest ½ oz. aniline violet in 1 oz. alcohol in a suitable vessel, as above, for three hours; then add 1 qt. of distilled water, and heat gently till odor of spirit is dissipated. Then add 2 drachms gum arabic dissolved in ½ pt. water, and allow the whole to settle. This will bear dilution, if desired, with an additional quantity of distilled water.

3. Special Formula for Blue: Dissolve 15 grains aniline blue in 1 oz. alcohol, and add 6 oz. in distilled water. Boil in proper vessel, as above, until odor of alcohol has disappeared. Then add 3 drachms powdered gum arabic dissolved in 4 oz. distilled water. Finally filter. It will be perceived that there is considerable difference in the above special formulæ, but there can be no harm in making it too strong, as it is no difficult matter to dilute with distilled water to taste.

Aqueous Solutions.—1. Magenta, 1 oz. to the gallon of boiling distilled water. 2. Violet: ½ oz. to a gallon ditto. 3. Blue: 1 oz [illegible] pts. ditto. 4. Green: 1 oz. to 5 pts. ditto.

The addition of a small quantity of vinegar will considerably improve the color of blue aniline fluid. These aqueous solutions are very enduring, though not exactly permanent, as they give way to long-continued exposure to sunlight. They are very limpid, dry quickly, and never clog. They should of course be filtered.

Gold Ink.—Grind gold-leaf with honey in a mortar until it is reduced to a fine powder. Wash out the honey with hot water and add mucilage of gum arabic. A cheap article may be made by using yellow bronze powder.

Silver Ink.—Prepared in the same way as gold ink, using silver leaf or silver bronze powder.

Marking Ink for Linen.—Dissolve ¼ oz. nitrate of silver in 1 oz. water and add strong liquid ammonia until the precipitate which is at first formed is redissolved. Add 1½ drachms gum mucilage and enough coloring matter to render the writing clearly visible. The writing is made black and indelible by passing a hot iron over it. Keep in the dark.

Indelible Aniline Ink.—Triturate 1¾ grammes of aniline-black with 60 drops of strong hydrochloric acid and 42 or 43 grammes strongest alcohol; then add to it a hot solution of 2½ grammes gum arabic in 170 grammes of water.

This ink attacks steel pens but little. It is not destroyed either by strong mineral acids or by strong lye.

If the first alcoholic solution of aniline black be diluted with a solution of 2½ grammes of shellac in 140 grammes of alcohol (instead of gum arabic in 170 grammes of water) an ink is produced which may be employed for writing on wood, brass or leather, and which is remarkable for its deep black color.

Indelible Indian Ink.—Draughtsmen are well aware of the fact that lines drawn on paper with good India ink which has been well prepared, can not be washed out by mere sponging or washing with a brush. Now, however, it is proposed to take advantage of the fact that glue or gelatine, when mixed with bichromate of potassa, and exposed to the light, becomes insoluble, and thus renders India ink, which always contains a little gelatine, indelible. Reisenbichler, the discoverer, calls this kind of ink "Harttusch," or "hard India ink;" it is made by adding to the common article, when making, about one per cent., in a very fine powder, of bichromate of potash This must be mixed with the ink in

a dry state; otherwise, it is said, the ink could not be ground up easily in water. Those who can not provide themselves with ink prepared as above in the cake, can use a dilute solution of bichromate of potash in rubbing up the ink; it answers the same purpose, though the ink should be used thick, so that the yellow salt will not spread.

Indestructible Ink..—An ink that can not be erased with acids is obtained by the following recipe: To good gall ink add a strong solution of fine soluble Prussian blue in distilled water. This addition makes the ink, which was previously proof against alkalies, equally proof against acids, and forms a writing fluid which cannot be erased without destroying the paper. The ink writes greenish blue, but afterwards turns black.

Ink that will not Freeze.—It is said that a mixture of equal parts of concentrated glycerine, alcohol and water, deeply colored with aniline black, does not freeze in the coldest weather, flows freely from the pen, and does not spread. Our only fear would be that such ink would not dry thoroughly.

Sympathetic Ink or Secret Ink.—Write with thin solution of starch, and let the correspondent wash with solution of iodine.

2. Write with milk, onion juice or lemon juice, and let the correspondent expose to heat.

3. Write with solution of tartar emetic and wash with any alkaline sulphuret.

4. Brown.—On dissolving 1 part of potassium bromide, and 1 part of copper sulphate in 20 parts of water, and writing with the solution on paper, *very careful* heating will turn the writing brown.

5. Yellowish-green.—Writing done with a solution of 2 parts of potassium chromate, 2 of nitric acid, 2 of sodium chloride in 40 parts of water, turns yellowish-green on gentle warming.

6. Blue.—A solution of equal parts of sodium chloride and cobalt chloride in 20 times the amount of water produces lines which turn blue on gentle warming.

Letters may be written on postal cards with these inks, and will remain invisible until washed with the appropriate solution or exposed to heat. To prevent the letters from being seen by close scrutiny the solutions should be very

dilute, and to distract the attention of those not in the secret, write some unimportant matter, in lines far apart, and between them write the private matter in secret or sympathetic ink.

Inks for Rubber Stamps and Stencils.—1. Black. Rub together one part of finest lampblack and 2 parts of Prussian blue with a little glycerin, then add 1 part powdered gum arabic, and enough glycerin to form a thin paste.

2. Carmine.—Dissolve 24 grains of carmine in 3 fl. oz. of water of ammonia, then add 2 fl. drachms of glycerin. Incorporate with this ½ oz. of powdered gum arabic.

3. Blue.—Rub together 6 parts of pure Prussian blue and 1 part oxalic acid with a little water, to a perfectly smooth paste. Let it stand in a rather warm place over night, then rub it with more water, and with 1 part of gum arabic to a thin paste.

4. Aniline inks may be made of any desired shade in the same manner. The best way of using these inks is by applying them, by means of a small pad, uniformly to a little cushion, on which the stamps are then inked.

The above formulæ have been tested by experience, and are said to give good results. Another set of formulæ, also highly recommended, is the following:

5. Black.—Finest lampblack, 10 parts; powdered gum arabic, 4 parts; glycerin, 4 parts; water, 3 parts. Dissolve the gum arabic in the water, add the glycerin, then rub the lampblack with the mixture in a mortar.

6. Colored.—Replace the lampblack in the above formula by the appropriate color; chrome-yellow for yellow; red lead or red ochre for red; green, ultramarine, or chrome-green for green; indigo or Prussian blue, or blue ultramarine for blue; umber for brown, etc.

Ink Eraser.

A good ink eraser is thus made: Take of chloride of lime, one pound, thoroughly pulverized, and four quarts of soft water. The above must be thoroughly shaken when first put together. It is required to stand twenty-four hours to dissolve the chloride of lime; then strain through a cotton cloth, after which add a teaspoonful of acetic acid to every ounce of the chloride of lime water. The eraser is used by reversing the penholder into the fluid, and applying it, without

rubbing, to the word, figure, or blot required to be erased. When the ink has disappeared, absorb the fluid with a blotter, and the paper is immediately ready to write upon again. Chloride of lime has before been used with acids for the purpose as above proposed ; but in all previous processes the chloride of lime has been mixed with acids that burn and destroy the paper.

Inlaying.

Inlaying is a term applied to work in which certain figures which have been cut out of one kind of material are filled up with another of a different color. Such work is known as marquetry, and also as Boule work, and Reisner work, from the names of two famous French artists.

The simplest method of producing inlaid work in wood, is to take two thin boards, of wood or veneers, and glue them together with paper between, so that they may be easily separated again. Then, having drawn the required figures on them, cut along the lines with a very fine, hair-like saw. This process is known as *counterpart sawing*, and by it the pieces removed from one piece of wood, so exactly correspond with the perforations in the other piece, that when the two colors are separated and interchanged, the one material forms the ground and the other the inlay or pattern. If the saw be fine and the wood very dry when cut, but afterwards slightly damped when glued in its place, the joint is visible only on very close inspection, and then merely as a fine line. After being cut, the boards or veneers are separated (which is easily done by splitting the paper between them), and then glued in their places on the work which they are to ornament.

Imitation Inlaying.—Suppose an oak panel with a design inlaid with walnut is wanted. Grain the panel wholly in oil. This is not a bad ground for walnut. When the oak is dry, grain the whole of the panel in distemper. Have a paper with the design drawn thereon, the back of which has been rubbed with whiting, place it on the panel, and with a pointed stick trace the design. Then with a brush and quick varnish trace the whole of the design. When the varnish is dry, with a sponge and water remove the distemper, where the varnish has not touched. This, if well executed, presents a most beautiful imitation of inlaid wood. Marbles are executed in a similar manner.

Iron.

This is undoubtedly the most important metal used in the arts. Directions for working it, such at least as would be valuable to professional blacksmiths, would occupy more space than we can afford, and we therefore content ourselves with a few hints for amateurs.

Forging.—As a general rule, those who are not practical blacksmiths had better take their work to a smith's shop. Cases may, however, arise where it is necessary to forge some little job, and the following hints may prove of use.

In working iron a great deal depends upon the degree of heat to which it is raised. Blacksmiths distinguish five degrees, which they name as follows :

1. The black-red heat, just visible by daylight.
2. The low-red heat.
3. The bright red heat, when the black scales may be seen.
4. The white heat, when the scales are scarcely visible.
5. The welding heat, when the iron begins to burn with vivid sparks.

Of these temperatures the 1st, 2nd and 3rd are easily attained in a common stove or grate. It requires good management to secure the 4th in a common stove, and the 5th can hardly be obtained without a blast. The higher the temperature the softer and more easily worked the metal becomes, and the less liable to crack or split ; and as good iron is not easily spoilt, like steel, by a high heat, it is always best to get the metal pretty soft.

Welding.—This operation requires considerable skill. The two great points to be attended to in making a perfect weld are that the metal shall be brought to a proper temperature, and that the surfaces to be united shall be perfectly clean. The latter point can only be secured by protecting the iron from the action of the air by means of some flux. Sand is generally used by blacksmiths and answers very well. When sand is brought into contact with oxide of iron at a high temperature, it combines with it and forms a fusible glass which flows over the surface of the iron and is easily driven out of the joint by pressure. Borax makes a still more fusible flux and may be successfully used by amateurs, but is too expensive for common use.

When two surfaces of iron, which have been cleansed by means of sand or borax, are brought together at a high heat

and forcibly pressed into contact by hammering or pressure, they unite to form a solid mass. Bearing these principles in mind, a little practice will soon enable any one to make a respectable joint by welding.

Case-hardening.—This process is simply the conversion of the surface of a piece of iron into steel. Case-hardened articles, when plunged into cold water while highly heated, become as hard as the hardest steel, but they may be annealed and softened so as to be easily worked with files and turning tools, and afterwards hardened again so as to be as durable as ever. There are several processes for performing this operation. The following have been tested by experience :

1. Where it is desired that the articles should be hardened to a considerable depth : Char a quantity of bones, just enough (*and no more*) to enable you to powder them with a hammer. Lay a layer of this bone dust over the bottom of an iron tray or box, which may be easily made by bending heavy sheet iron into form. Lay the articles to be hardened on the bone dust, taking care that they do not touch each other. Cover with bone dust and fill up the tray with spent dust, charcoal or sand. Expose to a bright cherry red heat for half an hour or an hour, and then turn the entire contents of the tray into a vessel of cold water. We have seen beautiful results obtained by this process when carried out in a common kitchen stove.

Even raw bone dust, such as is sold for farming purposes, may be used with good results. Pieces of gas pipe make good receptacles to hold the work, the ends being stopped with iron plugs. When packing the articles in the tubes or trays, see that they do not touch each other.

Bone black or ivory black may also be used, and, as they may be purchased ready prepared, we may avoid the disagreeable process of roasting the raw material.

As this roasting of bones, leather, etc., gives rise to most abominable odors, the author of this manual some years ago devised the following preparation, which was found to give very excellent results. Prepare a strong solution of prussiate of potassa, boil in it as much coarsely-powdered wood charcoal as can be mixed with it. Drain off the superfluous liquid, spread the charcoal on a board, and dry by exposure to the air. When dry, roast it at a temperature just below that of ignition, the object being to drive off all moisture,

but not to decompose the prussiate, which, at a red heat, is converted into cyanide of potassium and some other compounds. The charcoal thus prepared, and afterwards reduced to a moderately fine powder, will be found to answer quite as well as animal charcoal, and no difficulty will be found in case-hardening to a depth which will allow of a good deal of polishing before the soft metal underneath is reached.

2. Where mere superficial hardening is required, heat the article to be hardened to a bright red; sprinkle it liberally with powdered prussiate of potash. The salt will fuse, and if the piece of iron is small and gets cooled, heat it again and plunge into cold water.

Rust and Corrosion.—Iron is easily corroded by even the weak acids. Sulphuric acid, nitric acid, and hydrochloric acid all act on it quickly and powerfully. Air and moisture also quickly corrode it. It is a curious fact that carbonate of soda protects iron very perfectly from rust. We have seen a piece of iron that had been kept in a solution of soda for twenty years, and yet was quite bright.

There are several methods of protecting iron from rust. Painting, varnishing, tinning, zincing, etc., have all been tried with good effect. Painting and varnishing need no remarks. Where bright work is to be temporarily protected, however, a paint of white lead and tallow may be used. This will not dry, and may be easily and quickly removed with a little turpentine.

Zincing Iron.—The following is an excellent and cheap method for protecting from rust, iron articles exposed to the atmosphere, such as cramp-irons for stone, etc.: They are to be first cleansed by placing them in open wooden vessels, in water containing three-fourths to one per cent. of common sulphuric acid, and allowed to remain in it until the surface appears clean, or may be rendered so by scouring with a rag or wet sand. According to the amount of acid, this may require from six to twenty-four hours. Fresh acid must be added according to the extent of use and of the liquid; when this is saturated with sulphate of iron, it must be renewed. After removal from this bath, the articles are rinsed in fresh water, and scoured until they acquire a clean metallic surface, and then kept in water in which a little slaked lime has been stirred, until the next operation. When thus freed from rust, they are to be coated with a thin film of zinc, while cold, by

means of chloride of zinc, which may be made by filling a glazed earthen vessel, of about two-thirds gallon capacity, three-fourths full of muriatic acid, and adding zinc clippings until effervescence ceases. The liquid is then to be turned off from the undissolved zinc, and preserved in a glass vessel. For use, it is poured into a sheet-zinc vessel, of suitable size and shape for the objects, and about 1·30 per cent. of its weight of finely powdered sal ammoniac added. The articles are then immersed in it, a scum of fine bubbles forming on the surface in from one to two minutes, indicative of the completion of the operation. The articles are next drained, so that the excess may flow back into the vessel. The iron articles thus coated with a fine film of zinc are placed on clean sheet iron, heated from beneath, and perfectly dried, and then dipped piece by piece, by means of tongs, into very hot (though not glowing) molten zinc, for a short time, until they acquire the temperature of the zinc. They are then removed and beaten, to cause the excess of zinc to fall off.

Cold Process for Zincing Iron.—The metal is first cleaned by being placed in a bath made up of water, 1,000 litres; chlorhydric acid, 550 litres; sulphuric acid, 50 litres; glycerine, 20 litres. On being removed from this bath, the metal is placed in a bath containing 10 per cent. of carbonate of potassa, and is next transferred to a metallizing bath, consisting of water, 1,000 litres; chloride of tin, 5 kilos.; chloride of zinc, 4 kilos.; bitartrate of potassa, 8 kilos.; acid sulphate of alumina, 4 kilos.; chloride of aluminum, 10 kilos. The metal is to be left in this mixture for from three to twelve hours, according to the thickness of the layer of zinc to be desired.

Tinning Iron.—The surface of the iron is cleaned from scale by vitriol or sulphuric acid, and then scoured with sand. It is now coated with a strong solution of chloride of zinc, and dipped into melted tin. The tin will instantly adhere to every spot that is clean.

Tinning Iron in the Cold.—The chief point which requires attention in this matter is that the tinning of iron in the cold cannot succeed at all, unless the bath contains, in solution or suspension, an organic substance like starch or glucose, although no precise scientific explanation of this indispensible condition has been hitherto given. To 100 litres of water are added 3 kilos. of rye meal; this mixture is boiled

for half an hour, and next filtered through cloth ; to the clear but thickish liquid are added 106 kilos. of pyrophosphate of soda, 17 kilos. of protochloride of tin in crystals (so-called tin-salt), 67 kilos. of neutral protochloride of tin, 100 to 120 grms. of sulphuric acid ; this liquid is placed in well-made wooden troughs, and serves more especially for the tinning of iron and steel wire (previously polished) for the use of carding machines. When instead of the two sorts of tin just named, cyanide of silver and cyanide of potassium are taken, the iron is perfectly silvered.

Brightening Iron.—A Bavarian serial contains a method of brightening iron recommended by Boden. The articles to be brightened are, when taken from the forge or the rolls, in the case of such articles as plates, wire, etc., placed in dilute sulphuric acid (1 to 20), cleansing the articles, which are then washed clean with water and dried with sawdust. They are then dipped for a second or so in nitrous acid, washed carefully, dried in sawdust and rubbed clean. It is said that iron goods thus treated acquire a bright surface, having a white glance, without undergoing any of the usual polishing operations. This is a process that those interested can easily test for themselves. Boden states that the action of the sulphuric acid is increased by the addition of a little carbolic acid, but it is difficult to see what effect this can have, and it may very well be dispensed with.

To Remove the Blue Color Imparted to Iron and Steel by exposure to Heat.—Rub lightly with a sponge or rag dipped in diluted sulphuric, nitric, or hydrochloric acid. When the discoloration is removed, carefully wash the article, dry it by rubbing, warm it and give a coat of oil or it will rapidly rust.

Ivory.

Ivory is obtained from the tusk of the elephant, and although material nearly resembling it may be obtained from other animals, yet the true ivory stands unequalled as a material for ornamental turning and carving. It is not so brittle as bone, neither does it splinter so much when broken, and as it is entirely free from the vessels or pores which permeate all bone, the finished articles have a much more solid and even appearance. Although distinctly fibrous it cannot be torn up in filaments like bone or divided into thin leaves,

except by the saw. It is in all respects the most suitable material for ornamental turning, as it is capable of receiving the most delicate lines and of being cut in the most slender proportions. But while it is thus valuable as a material for ornamental work, it is useless for any article requiring accuracy in its dimensions—such for example as the scales of draughtsmen and the graduated arcs of instruments for measuring angles. Owing to the great alterations which it sustains under slight atmospheric changes it cannot be relied upon, and has been condemned officially by the survey commissioners of almost all countries.

It is imagined by some that ivory may be softened so as to admit of being moulded like horn or tortoise shell. Its different analysis contradicts this expectation; thick pieces suffer no change in boiling water, thin pieces become a little more flexible, and thin shavings give off their jelly, which substance is occasionally prepared from them. It is true that the caustic alkali will act upon ivory as well as upon most animal substances, yet it only does so by decomposing it. Ivory, when exposed to the alkalies, first becomes unctuous or saponaceous on its outer surface, then soft, if in thin plates, and it may be ultimately dissolved provided the alkali be concentrated; but it does not in any such case resume its first condition.

Working and Polishing Ivory.—As a material to be worked by the mechanic, ivory stands midway between wood and brass, and is turned and cut by tools having more obtuse angles than those employed for wood, and yet sharper than those used for brass. It may be driven at a fair speed in the lathe, and is easily sawed by any saw having fine teeth.

The tools used for cutting and turning ivory should have their edges very finely finished on an oil stone so that they may cut smoothly and cleanly.

Turned works with plain surfaces may in general be left so smooth from the tool as to require but *very little polishing*, a point always aimed at with superior workmen by the employment of sharp tools. In the polishing of turned works very fine glass paper or emery paper is first used, and it is rendered still finer and smoother by rubbing two pieces together face to face; secondly, whiting and water as thick as cream is then applied on wash leather, linen, or cotton rag, which should be thin that the fingers may the more readily feel and

avoid the keen fillets and edges of the ivory work, that would be rounded by excessive polishing; thirdly, the work is washed with clean water, applied by the same or another rag; fourthly, it is rubbed with a clean, dry cloth until all the moisture is absorbed, and, lastly, a very minute quantity of oil or tallow is put on the rag to give a gloss.

Scarcely any of the oil remains behind, and the apprehension of its being absorbed by the ivory and disposing it to turn yellow may be discarded; indeed the quantity of oil used is quite insignificant, and its main purpose is to keep the surface of the ivory slightly lubricated, so that the rag may not hang to it and wear it into rings or groovy marks. Putty powder is sometimes used for polishing ivory work, but it is more expensive and scarcely better suited than whiting, which is sufficiently hard for the purpose.

The polishing of irregular surfaces is generally done with a moderately hard nail brush, supplied with whiting and water, and lightly applied in all directions, to penetrate every interstice; after a period the work is brushed with plain water and a clean brush, to remove every vestige of the whiting. The ivory is dried by wiping and pressing it with a clean linen or cotton rag, and is afterwards allowed to dry in the air, or at a good distance from the fire; when dry a gloss is given with a clean brush on which a minute drop of oil is first applied.

It is better to do too little polishing at first, so as to need a repetition of the process rather than by injudicious activity to round and obliterate all the delicate points and edges of the works, upon the preservation of which their beauty mainly depends.

Bleaching and Cleaning Ivory.—In reply to the question, What means there are of bleaching ivory which has become discolored? Holtzapffel, the great authority on such subjects, tells us that he regrets to be obliged to say that he is unacquainted with any of value. It is recommended in various popular works to scrub the ivory with Trent sand and water, and similar gritty materials; but these would only produce a sensible effect by the removal of the external surface of the material, which would be fatal to objects delicately carved by hand or with revolving cutting instruments applied to the lathe.

It is a well known fact that ivory suffers the least change

of color when it is exposed to the *light* and closely covered with a glass shade. It assumes its most nearly white condition when the oil with which it is naturally combined is recently evaporated ; and it is the custom in some thin works, such as the keys of pianofortes, to hasten this period, by placing them for a few hours in an oven heated in a very moderate degree, although the more immediate object is to cause the pieces to shrink before they are glued upon the wooden bodies of the keys. Some persons boil the transparent ivory in pearl-ash and water to whiten it ; this appears to act by the superficial extraction of the oily matter as in bone, although it is very much better not to resort to the practice, which is principally employed to render that ivory which is partly opaque and partly transparent, of more nearly uniform appearance. It is more than probable, however, that the discoloration of ivory is due to the oil which it contains or has absorbed, and which becomes yellow and rancid, and every effort should be made to prevent oily or greasy bodies from coming in contact with ivory. Thus the keys of a pianoforte should be kept clean by carefully washing from the fingers the natural grease which all skin gives out. When ivory keys become very yellow they may be considerably whitened by allowing a paste of whiting, slightly moistened with potash, to lie on them for twenty-four hours. The potash extracts the oil which is absorbed by the chalk and may be thus removed.

It is a well known fact that most oils and resins may be bleached by exposure to sunlight. It is by this means that opticians render Canada balsam clear and transparent. It has been found that pieces of apparatus made of ivory, such as rules, etc., which have become yellow by age, may be bleached by dipping them in turpentine and exposing them to sunlight.

The fumes of sulphur, chloride of lime, etc., though frequently recommended, are of no value as bleachers of ivory.

Javelle Water.

This name was derived from the town of *Javelle*, in France, where a manufactory sold a liquor which had the property of bleaching cloth by an immersion of some hours only. The following is the original recipe given by Gray in his "Operative Chemist": 2½ lbs. common salt, 2 lbs of sulphuric

acid, and ¾ lb. of black manganese are mixed in a retort and heated, and the gas which comes over is condensed in 2 gallons of water in which 5 lbs. of potash have been dissolved. This liquor is diluted with twelve times its bulk of water.

This process is available only by chemists, however. The following gives good results : Take 4 lbs. carbonate of soda, and 1 lb. chloride of lime ; put the soda into a kettle, add 1 gallon of boiling water and boil for from 10 to 15 minutes ; then stir in the chloride of lime, breaking down all lumps with a wooden spatula or stirrer. Pour into large glass bottles ; when cold and settled it will be ready for use.

This forms a very efficient bleaching liquid and one which it is not difficult to remove from the bleached fabric. Old and stained engravings and books, as well as linen and cotton goods that have become yellow with dirt and age, may be rendered snowy white by the application of this liquid

Jewelry and Gilded Ware.

Ordinary gold jewelry may be effectually cleansed by washing with soap and warm water, rinsing in cold water and drying in warm boxwood sawdust. Plain, smooth surfaces may be rubbed with chamois leather charged either with rouge or prepared chalk, but the less rubbing the better.

Silver is liable to tarnish by the action of sulphur, and where there is fine chased or engraved work the extreme delicacy of the lines may be injured by much rubbing. In such cases the articles may be cleaned by washing with a solution of hyposulphite of soda. Cyanide of potassium is a more powerful cleansing agent but is very poisonous.

In cleaning gilded ware, different processes must be used for articles gilded by fire or by the galvanic process, and articles gilded by gold leaf, such as frames, etc. For cleaning articles gilded by the first-named methods, one part of borax is dissolved in sixteen parts of water. With this solution the article is carefully rubbed by means of a soft sponge or brush, then rinsed with water, and finally dried with a linen rag, or if small, such as a piece of jewelry, with boxwood sawdust. If at all convenient, the article is warmed previously to being rubbed, by which means the brilliancy of it is greatly increased. In cleaning gilded frames of the last named order, pure water only must be employed, and the rubbing off of the impurities must take place by means of a

very slight pressure. Wares of imitation gilt are generally covered with a shellac or resin varnish, which would be dissolved by the application of soap water, alkaline solutions, or spirits of wine. Were the varnish rubbed off, the exceedingly thin layer of gold or silver leaf beneath would also disappear. In our experience we have seen hundreds of once valuable but now worthless frames, they having become thus simply by the application of soap water.

Lacquer.

Lacquer is so called because it usually contains gum *lac*, either shellac or seed lac. Seed lac is the original form of the gum or resin ; after being purified it is moulded into thin sheets, like shell, and hence is called *shellac*. Shellac is frequently bleached so as to become quite white, in which state it forms a colorless solution. Bleached shellac is never as strong as the gum in its natural condition, and unless it be fresh it neither dissolves well in alcohol nor does it preserve any metal to which it may be applied.

There are many recipes for good lacquer, but the success of the operator depends quite as much upon skill as upon the particular recipe employed. The metal must be cleaned perfectly from grease and dirt, and in lacquering new work it is always best to lacquer as soon after polishing as possible. Old lacquer may be removed with a strong lye of potash or soda, after which the work should be well washed in water, dried in fine beech or boxwood sawdust and polished with whiting, applied with a soft brush. The condition of the work, as to cleanliness and polish, is perhaps the most important point in lacquering.

The metal should be heated and the lacquer applied evenly with a soft camel hair brush. A temperature of about that of boiling water will be found right.

The solution of lac or varnish is colored to suit the requirements or taste of the user.

A good pale lacquer consists of three parts of Cape aloes and one of turmeric to one of simple lac varnish. A full yellow contains four of turmeric and one of annatto to one of lac varnish. A gold lacquer, four of dragon's-blood and one of turmeric to one of lac varnish. A red, thirty-two parts of annatto and eight of dragon's-blood to one of lac varnish.

A great deal depends, also, upon the depth of color im-

parted to the lacquer, and as this may require to be varied, a very good plan is to make up a small stock bottle, holding, say, half a pint, according to any good recipe, and add as much of it to the varnish as may be required for the desired tint.

The following are a few favorite recipes :

Deep Gold Lacquer.—Alcohol, ½ pint ; dragon's-blood, 1 drachm ; seed lac, 1½ oz.; turmeric, ¼ oz. Shake up well for a week, at intervals of, say, a couple of hours ; then allow to settle, and decant the clear lacquer ; and if at all dirty filter through a tuft of cotton wool. This lacquer may be diluted with a simple solution of shellac in alcohol and will then give a paler tint.

Bright Gold Lacquer.—1. Turmeric, 1 oz.; saffron ¼ oz.; Spanish annatto, ¼ oz.; alcohol, 1 pint. Digest at a gentle heat for several days ; strain through coarse linen ; put the tincture in a bottle and add 3 oz. good seed lac coarsely powdered. Let it stand for several days, shaking occasionally. Allow to settle and use the clear liquid.

2. Take 1 oz. annatto and 8 oz. alcohol. Mix in a bottle by themselves. Also mix separately 1 oz. gamboge and 8 oz. alcohol. With these mixtures color seed lac varnish to suit yourself. If it be too red add gamboge ; if too yellow add annatto ; if the color be too deep, add spirit. In this manner you may color brass of any desired tint.

Pale Gold Lacquer.—Best pale shellac (picked pieces), 8 oz.; sandarac, 2 oz.; turmeric, 8 oz.; annatto, 2 oz.; dragon's-blood, ¼ oz.; alcohol, 1 gallon. Mix, shake frequently till the gums are dissolved and the color extracted from the coloring matters and then allow to settle.

Lacquer used by A. Ross.—4 oz. shellac and ¼ oz. gamboge are dissolved by agitation, without heat, in 24 oz. pure pyro-acetic ether. The solution is allowed to stand until the gummy matters, not taken up by the spirit, subside. The clear liquor is then decanted, and when required for use is mixed with 8 times its quantity of alcohol. In this case the pyro-acetic ether is employed for dissolving the shellac in order to prevent any but the purely resinous portions being taken up, which is almost certain to occur with ordinary alcohol ; but if the lacquer were made entirely with pyro-acetic ether, the latter would evaporate too rapidly to allow time for the lacquer to be equally applied.

Lacquers suffer a chemical change by heat and light, and must, therefore, be kept in a cool place and in dark vessels. The pans used should be either of glass or earthenware, and the brushes of camel's hair with no metal fittings.

Laundry Gloss.

Various recipes have been given for imparting a fine gloss to linen. Gum arabic, white wax, spermaceti, etc., have all been highly recommended, and are, no doubt, useful to a certain extent, but the great secret seems to lie in the quality of the iron used and the skill of the laundress. If the iron is hard, close grained and finely polished, the work will be much easier. Laundresses always have a favorite smoothing iron with which they do most of their work, and many of them have the front edge of the iron rounded so that great pressure can be brought to bear on a very small spot instead of being spread over a space the size of the whole face of the iron. If smoothing irons have become rough and rusty it will pay to send them to a grinder to have them not only ground but *buffed* (see aritcle on *Polishing Metals*). The greatest care should be taken not to allow them to get spotted with rust, and they should never be "brightened" with coarse sand, ashes, emery, etc. If it is necessary to polish them, rub them on a board, or preferably a piece of leather charged with the finest flour of emery, obtained by washing, or better still, jeweller's rouge.

Leaves—Skeleton.

The following is a simple method of preparing skeleton leaves, and is decidedly preferable to the old and tedious method of maceration, as it is quite as efficient and not at all offensive. First dissolve four ounces of common washing soda in a quart of boiling water, then add two ounces of slaked quicklime and boil for about fifteen minutes. Allow the solution to cool: afterwards pour off all the clear liquor into a clean saucepan. When this liquor is at its boiling heat place the leaves carefully in the pan, and boil the whole together for an hour, adding from time to time enough water to make up for the loss by evaporation. The epidermis and parenchyma of some leaves will more readily separate than others. A good test is to try the leaves after they have been gently boiling for an hour, and if the cellular matter does not easily rub off betwixt the finger and thumb beneath cold

water, boil them again for a short time. When the fleshy matter is found to be sufficiently softened, rub them separately but very gently beneath cold water until the perfect skeleton is exposed.

The skeletons, at first, are of a dirty white color; to make them of a pure white, and therefore more beautiful, all that is necessary is to bleach them in a weak solution of chloride of lime—a large teaspoonful of chloride of lime to a quart of water; if a few drops of vinegar are added to the solution it is all the better, for then the free chlorine is liberated. Do not allow them to remain too long in the bleaching liquor, or they will become too brittle, and cannot afterwards be handled without injury. About fifteen minutes will be sufficient to make them white and clean looking. Dry the specimens in white blotting paper, beneath a gentle pressure. Simple leaves are the best for young beginners to experiment on; the vine, poplar, beach and ivy leaves make excellent skeletons. Care must be exercised in the selection of leaves, as well as the period of the year and the state of the atmosphere when the specimens are collected; otherwise, failure will be the result. The best months to gather the specimens are July and August. Never collect specimens in damp weather, and none but perfectly matured leaves ought to be selected.

Lights—Signal and Colored.

The following recipes are from the United States Ordnance Manual, and may be considered reliable. The composition for signal lights is packed in shallow vessels of large diameter so as to expose considerable surface. Where the burning surface is large, the light attains great intensity, but the material burns out rapidly. In arranging the size and shape of the case, therefore, regard must be had to the time the light is expected to burn and the brilliancy that is wanted. [*See caution at end of this article.*]

Bengal Light.—Antimony, 2; sulphur, 4; mealed powder, 4; nitrate of soda, 16.

Blue.—Black sulphuret of antimony, 1; sulphur, 2; pure nitre, 6. Grind to a very fine powder and mix thoroughly. See that the nitre is perfectly dry. This composition gives a bluish white light; a deeper blue may be had by the addition of a little finely pulverized zinc.

Red.—1. Saltpetre, 5 ; sulphur, 6 ; nitrate of strontia, 20 ; lampblack, 1.

2. Nitrate of strontia, 20 ; chlorate of potassa, 8 ; Sulphur, 6 ; charcoal, 1.

White.—Saltpetre, 16 ; sulphur, 8 ; mealed powder, 4. Grind to a very fine powder and mix well.

The following have been very highly recommended :

Crimson Fire.—Sulphide of antimony, 4 ; chlorate of potassa, 5 ; powdered roll brimstone, 13 ; dry nitrate of strontia, 40 parts.

A very little charcoal added to the above makes it burn quicker.

Green Fire.—Fine charcoal, 3 ; sulphur, 13 ; chlorate of potassa, 8 ; nitrate of baryta, 77.

White.—1. Nitrate of potassa (saltpetre), 24 ; sulphur 7 ; charcoal, 1.

2. Nitre, 6 ; sulphur, 2 ; yellow sulphuret of arsenic, 1. [NOTE.—This light is a very brilliant one and a very pure white, but the fumes are highly poisonous. It should be used only in the open air and the wind should blow the vapors away from the spectators—not towards them.]

3. Chlorate of potash, 10 ; nitre, 5 ; lycopodium, 3 ; charcoal 2.

4. Metallic magnesium in the form of ribbon or wire. This is the best and most easily used. It may be purchased of most dealers in chemicals. A few inches of magnesium ribbon coiled into a spiral (like a spiral spring) and ignited by means of a spirit lamp, or even by a little tuft of cotton soaked in alcohol and fired with a lucifer match, makes a light of surpassing brilliancy and power. It requires a slight knack to ignite the ribbon. Hold the end of it steadily in the *outer edge* of the flame and it will soon take fire. The light given out by a small ribbon of magnesium is clearly visible at a distance of thirty miles.

Lights for Indoor Illuminations.—Many of the above are unfit for indoor exhibitions owing to the amount of sulphurous gas given off. For tableaux in churches, schools and private houses, the best light is undoubtedly magnesium or, where it can be had, the lime light (sometimes, though erroneously, called the calcium light). Both of these lights are very powerful, and any color may be obtained by the use of pieces of differently colored glass. A very effective

arrangement consists of a tin box, which may be made out of one of those cases in which crackers are imported. Pro cure good-sized pieces of red and blue glass, the red being a soft, warm tint, such as will add a richness to the complexions of those upon whom the light is thrown. Arrange one end of the tin box so that these glasses may be slipped over a large hole in it. The opposite end of the box should be highly polished so as to act as a reflector, and a hole should be cut in one side so as to allow of the introduction of the magnesium.

In every case the burning matter should be so shaded that it may not be seen by the audience. If the direct light from the burning body meets the eyes of the spectators the reflected light from the objects composing the tableau will have no effect.

Where arrangements for lime or magnesium lights cannot be made, the following may be used.

White.—Chlorate of potash, 12 ; nitre, 5 ; finely powdered loaf sugar, 4 ; lycopodium 2.

Green.—Nitrate of baryta, shellac and chlorate of potassa, all finely powdered, equal parts by bulk.

Red.—Nitrate of strontia, shellac and chlorate of potassa, all finely powdered, equal parts by bulk.

The brilliancy of these fires will depend largely upon the thoroughness with which the materials are finely powdered and mixed. [*See caution at end of this article.*]

Braunschweizer recommends the following formulæ as giving excellent results, the lights being good without producing injurious fumes :

Red.—Nitrate of strontia, 9 ; shellac, 3 ; chlorate of potassa, 1½.

Green.—Nitrate of baryta, 9 ; shellac, 3 ; chlorate of potassa, 1½.

Blue.—Ammoniacal sulphate of copper, 8; chlorate of potassa, 6; shellac, 1.

The *Pharmacist* gives the following formula for "Red Fire," which will not evolve sulphurous acid during combustion : nitrate of strontia, 1 lb.; chlorate of potassa, ¼ lb.; shellac, ¼ lb.

These ingredients must be thoroughly dried, powdered separately, and carefully mixed by gentle stirring.

Ghosts, Demons, Spectres and Murderers.—To give a ghastly

hue to the faces of the actors, the best light is that produced by some salt of soda, common salt being very good. We have succeeded well in this way : A piece of wire gauze such as ash-sifters are made of, and about a foot square, was supported at a height of about a foot from the floor, which was protected by a sheet of iron. On the wire gauze were laid twenty-five wads of cotton waste which had been soaked in a solution of common salt, dried and dipped in alcohol just before being laid on the wire. When these were ignited we had twenty-five powerful flames all tinged with sodium and burning freely, as the air rose readily among them through the wire grating. Such a flame produces quite a powerful light and gives a death-like appearance to even the most rosy-cheeked girl.

The following give a strong light and produce a most ghastly effect:

1. Nitrate of soda, 10 ; chlorate of potash, 10 ; sulphide of antimony, 3 ; shellac, 4. The materials must be warm and dry, and as the nitrate of soda attracts moisture rapidly, it must be well dried, then finely powdered as quickly as possible and kept in well-corked bottles. As this gives off a good deal of sulphurous fumes, the following may be preferred where the ventilation is not good :

2. Nitrate of soda, 10 ; chlorate of potassa, 15 ; white sugar finely powdered, 5 ; lycopodium, 2.

CAUTION.

In using chlorate of potassa the greatest care is necessary. It may be powdered and otherwise handled safely when alone, but when combustible matter of any kind is added to it, the mixture becomes highly explosive and must be very gently handled. It must therefore be powdered *separately* and only mixed with the other ingredients *after* they have been powdered. The mixing should be done on a large sheet of paper, very gently, but very thoroughly, with a thin, broad-bladed knife.

Mixtures of chlorate of potash with sulphur, sulphurets, and especially phosphorous, are liable to explode spontaneously after a time, and should never be kept on hand. They should be made as wanted.

Flowers of sulphur are very liable to contain a trace of sulphuric or sulphurous acid, which, acting upon chlorate of

potash causes spontaneous ignition. This may be obviated by pouring a few drops of liquid ammonia on the sulphur, mixing it up thoroughly and allowing it to stand for some time. A safe way also is to use powdered roll brimstone instead of flowers of sulphur.

Phosphorous Light.—One of the most brilliant lights known is produced by burning phosphorous in oxygen. The apparatus usually employed for this purpose is bulky and expensive, but the following is a very simple method of producing a very intense light by the combustion of phosphorous: Take an amount of nitre proportional to the desired intensity and duration of the light required, dry it thoroughly, powder it and pack it solidly in an earthen vessel, leaving a small cup-like hollow in its upper surface. In this hollow place a piece of phosphorous which has been carefully dried with soft paper or rags and set it on fire. As the phosphorous burns, the nitre melts, decomposes and furnishes it with pure oxygen, and the resulting light is very brilliant.

NOTE.—In handling phosphorous be very careful. Do not touch it with the hands or *rub* it with the article used to dry it, as it takes fire very easily, and the burns produced by it are very severe. It should always be cut under water.

Photographic Light.—A light of intense photographic power is produced by burning bisulphide of carbon in an argand lamp and passing a stream of nitric oxide through the centre of the flame Nitric oxide is easily produced as wanted by allowing nitric acid to act on scraps of copper.

The following specific directions will enable the reader to produce this light in a less simple but more effective manner: A quart bottle with a somewhat large mouth, has a cork with two openings. Through one of these a tube passes to near the bottom of the bottle; through the second a large tube packed with iron scale issues. Fragments of pumice fill the bottle, and on these carbon disulphide is poured. A current of nitric oxide gas, prepared by Deville's method—by the action of nitric and sulphuric acids on metallic iron contained in a self-regulating reservoir—is passed through the bottle, where it takes up the vapor of the disulphide. It is then led through the safety-tube, packed with iron-scale, to a gas burner of the required capacity Excellent photographs have been taken in five seconds with this light, the object being six feet distant. In photographic power the

light is asserted to be superior to the magnesium or calcium light, and even to surpass the electric light itself. The products of combustion are noxious and must be gotten rid of.

Chatham Light.—This is a most intense flash-light used for military signals. Three parts finely powdered resin are mixed with one part magnesium dust, and blown by means of a tube through the flame of a spirit lamp. The flame should be large so as to insure the ignition of all the dust. The distance at which such a flame can be seen is extraordinary.

Some years ago the author devised a method of producing a light of marvellous brilliancy by the use of magnesium powder. A rude argand spirit lamp was constructed in such a way that the central tube could be connected in an air-tight fashion with a reservoir of oxygen. A small stopcock, with the hole of the plug closed at one side so as to leave a *cup* instead of a hole, was fitted into the tube leading from the oxygen reservoir to the lamp. When turned upward this cup was easily filled with magnesium powder, and when turned down it of course dropped its charge into the stream of oxygen, which carried it at once to the lamp, there to be consumed in a flash of extraordinary brilliancy.

Looking Glass. (*See Mirrors.*)

Lubricators.

In selecting a lubricator for any rubbing surfaces, care must be taken to adapt the character of the lubricating material to the nature of the rubbing surfaces and the weight which they have to sustain. A fine, thin oil is useless for heavy bearings, and a hard, stiff soap, which would be excellent for such bearings, would be a poor article for a very light piece of machinery. In the case of heavy bearings, such as railway axles, when they once begin to heat and cut, it will be found impossible to prevent heating by the mere application of oil. The surfaces of the metal must be worked over either by grinding or the turning tool. Thus, when journals heat at sea, the usual custom is to use sulphur, black-lead, or water; but the relief they afford is only temporary. The following is a method that gives permanent relief: When you find the journals getting hot, slack back the nuts on the cap from one-quarter to one-third of a turn, and supply the journal

freely with dust procured by rubbing two Bath bricks together, mixed in oil to a consistency a little thinner than cream. After a short time begin cautiously to set up on the nuts; and before finally bringing the nuts to their original position, give a copious supply of oil alone to wash out the journal; then bring the nuts into position, and you will have no further trouble. This plan has also been tried on railway journals, and it has been found that a handful of clay or gravel has effected that which gallons of oil and water could not do.

In addition to the usual oils and grease the following lubricators deserve attention:

1. *Plumbago.*—This material is gradually coming into use, and when properly selected and applied it never fails to give satisfactory results. It may be used on the heaviest planers and ocean steamers, or on the lightest watchwork. When applied to delicate machinery the surfaces should be very lightly coated with the plumbago by means of a brush. In this way all danger of grit is avoided. Plumbago seems to be specially adapted to diminish the friction between porous surfaces, such as wood and cast iron. For the cast iron beds of heavy planers it is a specific.

2. *Anti-Attrition.*—Mix 4 lbs. tallow or soap with 1 lb. finely ground plumbago. The best lubricator for wood working on wood. Excellent for wooden screws where great power is required.

3. *Fine Lubricating Oil.*—Put fine olive oil in a bottle with scrapings of lead and expose it to the sun for a few weeks. Pour off the clear oil for use. Another method is to freeze fine olive oil, strain out the liquid portion and preserve for use.

Booth's Axle Grease.—Dissolve ½ lb. washing soda in 1 gallon water and add 3 lbs. tallow and 6 lbs. palm oil. Heat to 210° Fahr., and keep constantly stirring until cooled to 60° or 70°.

Marble.

Marble is a compact carbonate of lime which varies in color, some specimens being pure white, others perfectly black, while others are green, red, veined, mottled, etc. The famous Mexican onyx, so-called, is also a carbonate of lime, and notwithstanding its hardness and beauty is liable to injury from the same causes that affect ordinary marble.

Marble is easily dissolved, with escape of carbonic acid gas, by the mineral acids, sulphuric, nitric, hydrochloric, etc., and it is also acted upon, though more slowly by vinegar, the acids of fruit, etc. It is also soluble in water containing an excess of carbonic acid, and therefore dissolves rapidly in the ordinary "soda" water that is so generally sold as a beverage, for this fluid, in its pure state, consists solely of water holding a large amount of carbonic acid in solution. Consequently bottles and glasses of this liquid should not be placed where there is any danger of spilling it on mantel pieces, table tops, etc., as it will infallibly destroy the exquisite polish upon which the beauty of such articles of furniture depends.

Finely carved articles of marble, when exposed to the rain of our northern climates, are apt to suffer corrosion, and the delicate tracery of the sculptor is soon lost. Therefore, while marble answered very well in the comparatively dry climates of Greece and Egypt, it is unsuited for statues, etc., exposed to the open air, in England and America, the rainfall in these countries being very great, and the moisture heavily charged with carbonic and sulphurous acids.

In cleaning marble ornaments, etc., great care must be exercised to use nothing corrosive like acids, chlorides, or metallic salts, such as are usually recommended for removing stains of inks and dyes from wood and textile fabrics. When marble has been stained by ink or vegetable coloring matter, the only way to remove it is to apply warm water abundantly and for a long time. If the marble is very compact, and the stain consequently quite superficial, the article may be scraped and repolished, but of course this is applicable only to objects which have plane surfaces, or those with simple curves. Elaborately carved or sculptured objects could not be so treated.

Greasy stains may be removed by covering them with a paste of chalk and potash or soda. The alkali will convert the grease into soap, which will be gradually absorbed by the chalk and thus removed. In such cases, however, the stains, especially if old, may require a long time and several repetitions of the process. Alkalies (potash, soda and ammonia) may be applied to marble without injuring it, and any stains which they can remove may be taken out by their means.

Marble is easily worked either on the bench or in the lathe

In the latter case, however, great care must be taken to avoid anything like a heavy cut, since marble is so rigid and brittle that if the cut be heavy the article is apt to be broken. The only tool that can be used is a steel point, tempered to a straw color. The tool requires frequent grinding, and when it gets broad it must be forged over again, as a flat tool will not turn marble at all.

For working and finishing marble on the bench the following is the process: After the marble is sawn into slab, the first operation is to grind it down with a flat coarse sandstone and water, or with an iron plate, fed with fine sand and water, until all the marks of the saw are perfectly removed; secondly, a fine sandstone is used with water until the marks made by the first stone are removed; thirdly, a finer sandstone is applied to work out the marks of the former; fourthly, pumice stone with water, and fifthly, snake stone is used, and this last finishes what is called the *grounding*.

Next comes the polishing, which is principally performed with rollers of woolen cloth or list made to the size of about three inches diameter. As the sixth process, a rubber is charged with flour emery and a moderate degree of moisture; this rubber is worked uniformly over every part until the marble acquires a kind of greasy polish; seventhly, the work is completed with a similar roll of cloth charged with putty powder and water. Some prefer, as the polisher, an old cotton stocking not made into a rubber, and in some few of the more delicate works crocus is used intermediately between the emery and the putty powder. It is necessary to wash the marble after each operation, so that not a particle of the previous polishing material may remain, otherwise the work will be scratched.

The dull parts of sculpture are finished in four different manners, or rather the complete process of smoothing is discontinued at various stages so as to form four gradations, which may be described as follows:

First.—The marble is sometimes left from the long and very slender statuary's chisel, the reverse end of which is formed with a sharp circular edge or ridge, just like a hollow centre, in order that the metal hammer, which is of soft iron, tin or zinc, may be slightly indented by the chisel, so as to avoid its glancing off; the chisel marks leave the surface

somewhat rough and matted, intermediate between the granular and crystalline character.

Secondly.—For surfaces somewhat smoother, rasps are used to remove the ridges left by the chisel; the rasps leave a striated or lined effect suitable for draperies, and which is made more or less regular according to the uniformity of the strokes, or the reverse.

Thirdly.—Files are employed for still smoother surfaces of the same character; and it is to be observed that the files and rasps are generally curved at the ends, to adapt them to the curvilinear forms of the sculpture.

Fourthly.—For the smoothest of the dull or unpolished surfaces, the faint marks left by the file are rubbed out with Trent sand or silver sand and water, applied by means of a stick of deal cut to a point, and rubbed all over the work in little irregular circles, as a child would scribble on a slate and if the end of the stick is covered with two or three thicknesses of cloth the marble receives a still rounder or softer effect than from the naked stick, for which the cabbage wood or partridge wood is sometimes used, and the end of the stick is slightly bruised, so that the fibres of the wood may assume the character of the stiff brush, known by artists as a scrub.

Mr. Thomas Smith tells us that he has successfully copied the minute roughness or granulation of the skin, by a kind of etching which he was induced to try, by imagining that he could trace such a process to have been used in some of the most perfect of the ancient marbles that had not been exposed to the open air. The work having been smoothed with sand, as above, he takes a hard, stubby brush and therewith dots the marble with muriatic acid, and which quickly, yet partially, dissolves the surface. The strength of the acid, which must not be excessive, is tested upon a piece of waste marble; the brush is hastily dipped in the acid, applied to the work, quickly rinsed in water, and then used for removing the acid from the marble. It is obvious the process calls for a certain admixture of dexterity and boldness, and sometimes requires several repetitions, the process occupying only a few minutes each time.

Fifthly.—The bright parts of sculpture. Few of the works in sculpture are polished, and such as are, are required in the first instance to pass through the four stages already explained

for producing the smooth but dull surface; after which, slender square pieces of the second gritstone and of snake-stone are used with water as a pencil, and then fine emery and putty powder on sticks of wood; but the work is exceedingly tedious, and requires very great care, that the artistical character of the work, and any keen edges that may be required are not lost in the polishing.

Metals—Polishing.

Metals are polished either by burnishing or buffing. The process of burnishing consists in rubbing down all the minute roughnesses by means of a highly polished steel or agate tool—none of the metal being removed.

The action of the burnisher appears to depend upon two circumstances; first, that the harder the material to be polished the greater lustre it will receive; the burnisher is, therefore, commonly made of *hardened steel*, which exceeds in hardness nearly every metallic body. And secondly, its action depends on the intimacy of the contact betwixt the burnisher and the work; and the pressure of the brightened burnisher being, in reality, from its rounded or elliptical section, exerted upon only one mathematical line or point of the work at a time, it acts with great pressure and in a manner distinctly analogous to the steel die used in making coin; in which latter case the dull but smooth blank becomes instantly the bright and lustrous coin, in virtue of the intimate contact produced in the coining press between the entire surface of the blank and that of the highly polished die.

It by no means follows, however, that the burnisher will produce highly finished surfaces, unless they have been previously rendered smooth, and proper for the application of this instrument, as a rough surface, having any file marks or scratches, will exhibit the original defects, notwithstanding that they may be glossed over with the burnisher which follows every irregularity; and excessive pressure, which might be expected to correct the evil as in coining, only fills the work with furrows, or produces an irregular indented surface, which by workmen is said to be *full of utters*.

Therefore, the greater the degree of excellence that is required in burnished works, the more carefully should they be smoothed before the application of the burnisher, and this tool should also be cleaned on a buff stick with crocus im-

mediately before use; and it should in general be applied with the least degree of friction that will suffice. Cutlers mostly consider that burnishers for steel are best rubbed on a buff stick with the finest flour emery; for silver, however, they polish the burnisher with crocus as usual. Most of the metals, previously to their being burnished, are rubbed with oil to lessen the risk of tearing or scratching them, but for gold and silver the burnisher is commonly used dry, unless soap and water or skimmed milk are employed; and for brass furniture, beer or water, with or without a little vinegar, is preferred for lubricating the burnisher.

Buffing is performed by rubbing the metal with soft leather, which has been charged with very fine polishing powder. The rubbing is sometimes done by hand, but more frequently the buff is made into a wheel which revolves rapidly in a lathe and the work is held against it.

The polishing powder that is selected must be chosen with special reference to the metal that is to be buffed. Thus, for steel and brass the best polishing powder is crocus or rouge, which may be purchased of any dealer in tools, or may be made by exposing very clean and pure crystals of sulphate of iron to heat, according to the directions given hereafter under the head of *Polishing Powders*. The hardest part of the rouge must be selected, and great care must be taken to have it clean and free from particles of dust and sand, which would inevitably scratch the article to be polished and render it necessary to again repeat all the previous processes of filing, grinding, etc.

Soft metals like gold and silver may be polished with comparatively soft powders, such as prepared chalk or putty powder (oxide of tin).

When metals are to be polished in the lathe the process is very simple. After being turned or filed smooth the article is still further polished by means of fine emery and oil, applied with a stick, and in the case of rods or cylinders, a sort of clamp is used so that great pressure can be brought to bear on the part to be polished. The work must be examined from time to time to see that all parts are brought up equally to the greatest smoothness and freedom from scratches, and as fast as this occurs polishing powder of finer and finer quality is used, until the required finish is attained.

In polishing metals or any other hard substances by

abrasion, the great point is to bring the whole surface up equally. A single scratch will destroy the appearance of the finest work, and it cannot be removed except by going back to the stage to which it corresponds, and beginning again from that point. Thus, if in working with a smooth file we make a scratch as deep as the cut of a bastard file, it is of no use to try and remove this scratch with the smooth file, we must go back, and taking a bastard file make the surface as even as possible with it, and afterwards work forward through fine files and polishing powders.

Mirrors.

As it is frequently convenient to be able to silver a piece of glass for a special purpose, we quote from Faraday's work on Chemical Manipulation, the following directions for performing this operation :

A piece of clean, smooth tinfoil, free from holes, is to be cut to the same size as the glass and laid upon a couple of sheets of filtering or blotting paper folded into quarters. A little mercury is to be placed on the foil, and rubbed over it with a hare's foot, or with a ball of cotton slightly greased with tallow, until the whole of the upper surface of the leaf be amalgamated and bright. More mercury is then to be added, until the quantity is such as to float over the tinfoil. A piece of clean writing paper, with smooth edges, is to be laid upon the mercury, and then the glass surface, previously well cleaned, is to be applied to the paper. The paper is to be drawn out from between the mercury and the glass, while a slight but steady pressure is to be applied to the latter. As the paper recedes it carries all air and dirt with it from between the glass and the metal, which come into perfect contact.

The mirror is now made, and may be used for an experiment; but there is still much more mercury present than is required to make the definite and hard amalgam of tin constituting the usual reflecting surface. If it be desired to remove this excess, the newly-formed mirror must be put under the pressure of a flat board, in a slightly-inclined position, and loaded with weights.

The success of this operation will be found to depend chiefly upon the care exercised in cleaning the glass.

Silvering Glass Mirrors for Optical Purposes.—This is best

effected by depositing pure silver on the glass. The light reflected from a mirror made thus has somewhat of a yellowish tinge, but photometric experiments show that from 25 to 30 per cent. more light is reflected than from the old mercurial mirrors.

Where *ammonium aldehyde* can be obtained, there is no doubt that this is the best and most economical process, whether used on a large or a small scale. But those who have not had considerable experience in the laboratory cannot always prepare this compound.

The next best process is based upon the reduction of metallic silver from its ammoniacal solution by salts of tartar. After a trial of several formulæ of this kind, all of them more or less simple, as well as efficacious, the following has been found to yield the best results in the shortest time.

Silvering Solution.—In 1 ounce of distilled or pure rain water, dissolve 48 grains of crystalized nitrate of silver. Precipitate by adding strongest water of ammonia, and continue to add the ammonia drop by drop, stirring the solution with a glass rod, until the brown precipitate is nearly, but not quite redissolved. Filter, and add distilled water to make 12 fluid drachms.

Reducing Solution.—Dissolve in 1 ounce of distilled or very clean rain water, 12 grains of potassium and sodium tartrate (Rochelle or Seignette salts). Boil, in a flask, and while boiling add 2 grains crystalized nitrate of silver dissolved in 1 drachm of water. Continue the boiling five or six minutes. Let cool, filter, and add distilled water to make 12 fluid drachms.

To Silver.—Provision must be made for supporting the glass in a perfectly horizontal position at the surface of the liquid. This is best done by cementing to the face of the mirror three nice hooks by which it may be hung from a temporary framework—easily made out of a few sticks.

The glass to be silvered must be cleansed by immersing it in strong nitric acid, washing in liquor potassæ, and thoroughly rinsing with distilled water. If the glass has had mercurial amalgam on it, it will probably be necessary to clean the back with rouge. On having this surface perfectly, chemically clean, depends in a great measure the success of the operation.

Having arranged the contrivance for suspending the glass

so that it may be at exactly the right height in the vessel that is to receive the solution, remove this vessel and pour into it enough of equal quantities of the two solutions to fill it exactly to the previously ascertained level. Stir the solutions so that they will become thoroughly mixed, and replace the glass to be silvered, taking great care that the surface to be silvered shall come in contact with the silvering fluid exactly at all points. The glass plate should be rinsed carefully before replacing, and should be put in while wet. Great care should be taken that no air bubbles remain on the surface of the solution, or between it and the surface to be silvered.

Now set the vessel in the sun for a few minutes, if the weather be warm, or by the fire, if it be cold, as a temperature of 45° to 50° C. (113° to 122° Fah.) is most conducive to the rapid deposition of a brilliant, firm and even film of silver. The fluid in the sunlight soon becomes inky black, gradually clearing as the silver is reduced, until when exhausted it is perfectly clear. The mirror should be removed before this point is reached, as a process of bleaching sets up if left after the fluid is exhausted. From 20 to 80 minutes, according to the weather, purity of chemicals, etc., is required for the entire process.

When the mirror is removed from the bath, it should be carefully rinsed with distilled water from the wash bottle, and laid on its edge on blotting paper to dry. When perfectly dry, the back should be varnished with some elastic varnish and allowed to dry. The wires and cement can now be removed from the face, and the glass cleaned with a little fledget of cotton and a minute drop of nitric acid, taking great care that the acid does not get to the edges or under the varnish. Rinse, dry and the mirror is finished.

Silver Amalgam for Mirrors.—The great objections to mirrors coated with pure silver are the yellow character of the reflected light, and the fact that such mirrors are apt to be affected by sulphur. M. Lenoir has invented a process which is said to avoid these difficulties. The glass is first silvered by means of tartaric acid and ammoniacal nitrate of silver, or by the process described in the preceding section, and is then exposed to the action of a weak solution of double cyanide of mercury and potassium. When the mercurial solution has spread uniformly over the surface, fine zinc dust is powdered over it, which promptly reduces the quicksilver,

and permits it to form a white and brilliant silver amalgam, adhering strongly to the glass, and which is affirmed to be free from the yellowish tint of ordinary silvered glass, and not easily affected by sulphurous emanations.

Care of Looking Glasses.—When looking glasses are exposed to the direct rays of the sun or to very strong heat from a fire the amalgam is apt to crystallize and the mirror loses its brilliancy. If a mirror is placed where the rays of the sun can strike it, it should be covered in that part of the day during which it is exposed.

The best method of cleaning looking glasses is as follows: Take a newspaper, fold it small, dip it into a basin of clean cold water. When thoroughly wet squeeze it out as you do a sponge; then rub it pretty hard all over the surface of the glass, taking care that it is not so wet as to run down in streams; in fact, the paper must only be completely moistened or dampened all through. Let it rest a few minutes, then go over the glass with a piece of fresh newspaper till it looks clear and bright. The insides of windows may be cleaned in the same way; also spectacle-glasses, lamp-glasses, etc. White paper that has not been printed on is better; but in the absence of that, a very old newspaper, on which the ink has become thoroughly dried, should be used. Writing paper will not answer.

Nickel.

This is by far the most valuable metal that has been brought into notice during the past few years. It has been long familiar to chemists, and as a component of German silver, electrum, and similar alloys, it has been in common use, but as an unalloyed coating for other metals it has only been employed for about ten years.

It is hard, not easily corroded by acids, and, unlike silver, it is entirely unaffected by sulphur. In addition to these valuable qualities it has one of special importance in some cases, and that is the ease with which a nickel surface slides over any other smooth body. Hence, for the sliding parts of telescopes, microscopes, etc., it has come into very general use, and it is not improbable that it will prove of great value in the case of slide valves, pistons, etc.

Nickel is almost always applied as a coating by the electroplating process, for instructions in which art we must refer

our readers to any good work on the art of electro-metallurgy.

A foreign journal gives the following directions for nickel plating without a battery : To a solution of five to ten per cent. of chloride of zinc, as pure as possible, add sufficient sulphate of nickel to produce a strong green color, and bring to boiling in a porcelain vessel. The piece to be plated, which must be perfectly bright and free from grease, is introduced so that it touches the vessel as little as possible. Ebullition is continued from 30 to 60 minutes, water being added from time to time to replace that evaporated. During ebullition nickel is precipitated in the form of a white and brilliant coating. The boiling can be continued for hours without sensibly increasing the thickness of this coating. As soon as the object appears to be plated it is washed in water containing a little chalk in suspension, and then carefully dried. This coating may be scoured with chalk, and is very adherent. The chloride of zinc and also the sulphate of nickel used must be free from metals precipitable by iron. If during the precipitation the liquor becomes colorless, sulphate of nickel should be added. The spent liquor may be used again by exposing to the air until the contained iron is precipitated, filtering and adding the zinc and nickel salts as above. Cobalt also may be deposited in the same manner.

Noise—Prevention of.

To those who carry on any operations requiring much hammering or pounding, a simple means of deadening the noise of their work is a great relief. Several methods have been suggested, but the best are probably these :

1. Rubber cushions under the legs of the work-bench. *Chamber's Journal* describes a factory where the hammering of fifty coppersmiths was scarcely audible in the room below, their benches having under each leg a rubber cushion.

2. Kegs of sand or sawdust applied in the same way. A few inches of sand or sawdust is first poured into each keg ; on this is laid a board or block upon which the leg rests. and round the leg and block is poured fine dry sand or sawdust. Not only all noise, but all vibration and shock, is prevented ; and an ordinary anvil, so mounted, may be used in a dwelling house without annoying the inhabitants. To amateurs, whose workshops are almost always located in

dwelling houses, this device affords a cheap and simple relief from a very great annoyance.

Painting Bright Metals.

When paint is applied to bright metals like tin or zinc, it is very apt to peel off. This difficulty is greatly lessened if the metal be hot when the paint is applied, but in many cases this cannot be done. In such cases the surface of the metal should be corroded, for which purpose a solution of sulphate of copper, acidulated with nitric acid answers well. The metal should be washed with the solution, allowed to stand a couple of hours, and then washed with clean water and dried.

Painting the Hours on Metal Dials.—The black coloring matter is the soot obtained by holding a clean copper or sheet metal plate over the flame of an oil or petroleum lamp (a glowing tool serves the purpose very well). As soon as a sufficient deposit is produced it is collected on a piece of glass, care being taken not to mix any foreign substance with it. A few drops of essence of lavender are then poured on the soot and the mixture pounded with a spatula. This done, just sufficient copal varnish is added to give the composition a proper thickness, so as to prevent it spreading when applied. The varnish thus prepared is put on by means of a very fine brush. To secure brilliancy the dial is dried at a slow heat, by passing it lightly over a spirit flame, the reverse side of the dial being, of course, the only part exposed to the flame. This composition must be made in quantities large enough for present use only, as it dries very rapidly and cannot be utilized afterwards. To secure good results this process requires some experience, which can only be obtained by careful experiments. The painting especially requires a certain aptitude and lightness of hand, which may, however, soon be attained by strict attention.

This process, which gives very excellent results, is evidently applicable to a great variety of purposes.

Paper.

There are so many purposes to which paper is applied that a small volume might be filled with a description of them. The following are those which will probably prove most useful to the amateur :

Adhesive Paper.—Paper in sheets, half of which are

gummed on both sides, and the other half on one side, and divided into strips and squares of different sizes by perforations, like sheets of postage stamps, are very convenient in many ways—the doubly-gummed answering for fixing drawings in books, labels on glass, etc. It is stated that the mixture by which it is coated is prepared by dissolving six parts of glue, previously soaked for a day in cold water, two parts of sugar, and three parts of gum arabic, in twenty-four parts of water, by the aid of heat.

Barometer Paper.—This is paper impregnated with a so-called sympathetic ink, which alters its color by a change of temperature. The most delicate substance to accomplish this is *sulphocyanide of cobalt*, originally proposed by Grotthus. This is prepared by adding an alcoholic solution of potassium sulphocyanide to an aqueous solution of cobaltous sulphate, until no more potassium sulphate separates. The whole is transferred to a filter, and the residue on the filter (potassium sulphate) washed with alcohol. The dilute filtrate may be used as it is, for impregnating paper, or it may be concentrated by very careful evaporation at as low a temperature as possible. The salt may be obtained crystalline by removing the alcoholic menstruum in the vacuum of an air-pump. It forms violet columns, soluble in water with red color. Paper impregnated with the *alcoholic* solution, or on which tracings have been made with the latter, turns reddish in *dry* air, but assumes a *blue* color at the slightest elevation of temperature.

Creases, To Take out of Drawing Paper or Engravings.—Lay the paper or engraving, face downwards, on a sheet of smooth, unsized white paper ; cover it with another sheet of the same, very slightly damped, and iron with a moderately warm flat iron.

Drawing Paper, To Mount.—Sometimes it is difficult to get a drawing on a sheet of paper of the ordinary sizes when stretched upon a board, by reason of the waste edges used to secure the paper firmly ; and again, in stiff papers, such as the "Eggshell," so called, ordinary mucilage does not possess sufficient strength, and glue has to be substituted, to the annoyance of the draughtsman. The following is a very simple way of obviating these difficulties : First moisten the paper thoroughly ; then lay it upon the board in proper position, and, with blotting paper, remove most of the moisture for a distance of half an inch or thereabouts from the

edges; then take strips of Manila paper (not too stiff) about one and a half inches wide, covered on one side with mucilage, and paste them down on both paper and board, allowing them to lap on the edges of the sheet about half an inch. Keep the middle of the sheet thoroughly wet until the mucilage on the edges has set, when the whole sheet may be allowed to dry gradually. It will be found that this method is quicker and surer than any other, and is of great use where it is necessary to color on mounted paper.

Glass-Paper.—Paper coated with glass is known by this name just as paper coated with fine sharp sand is called *sand-paper*, and paper coated with emery is called *emery paper*. Paper or a cheap cloth is coated with thinnish glue, dusted heavily and evenly with glass-powder of the proper fineness, and allowed to become nearly dry. The superfluous powder is then shaken off, the sheets are pressed to make them even, and afterwards thoroughly dried.

The objection to ordinary glass-paper is that it is easily injured by heat and moisture. If the glue be mixed with a little bichromate of potassa before it is applied to the cloth, and exposed for some time to strong bright sunshine while it is drying, it will become insoluble in water.

The glue may also be rendered insoluble by the process of tanning. The paper or cloth is first soaked in a solution of tannic acid and dried. The glue is then applied, the powdered glass dusted on, and over it is dusted a little tannic acid. If the glue be not very moist, it should be damped by means of an atomiser, a very cheap form of which is figured in *The Young Scientist*, vol. 2. The sheets are then slowly dried and will be found to resist moisture very thoroughly.

Paper, To Prepare for Varnishing.—To prevent the absorption of varnish, and injury to any color or design on the paper, it is necessary to first give it two or three coats of size. The best size for white or delicate colors is made by dissolving a little isinglass in boiling water, or by boiling some clean parchment cuttings until they form a clear solution; then strain through a piece of clean muslin. It may be applied with a clean soft paint brush, the first coat, especially, very lightly. The best brush for this purpose is the kind used by varnishers for giving the finishing flow coats of varnish, wide, flat and soft; or where there is much danger of injuring a design, and the paper article will allow of it, it

is a good plan for the first coat, to pour the solution into a wide, flat dish, and pass the paper through it once, and back again, and then hang it up to dry. For less delicate purposes, a little light-colored glue, soaked over night in enough water to cover it, and then dissolved by heat, adding hot water enough to dilute it sufficiently, will make an excellent sizing.

Pollen Powder, or Paper Powder.—Boil white paper or paper cuttings in water for five hours. Pour off the water, pound the pulp in a wedgwood mortar, and pass through a fine sieve. This powder is employed by the bird stuffers to dust over the legs of some birds, and the bills of others, to give them a powdery appearance ; also to communicate the downy bloom to rough-coated artificial fruit, and other purposes of a similar nature ; it makes excellent pounce.

Tracing Paper.—Tracing paper may be purchased so cheaply that it is hardly worth while to make it ; and there is a very fine, tough kind now in market which may be mounted and colored almost like drawing paper. Those who desire to prepare some for themselves will find that the following directions give a good result. The inventor of the process received a medal and premium from the Society of Arts for it.

Open a quire of tough tissue paper, and brush the first sheet with a mixture of equal parts of mastic varnish and oil of turpentine. Proceed with each sheet similarly and dry them on lines by hanging them up singly. As the process goes on, the under sheets absorb a portion of the varnish, and require less than if single sheets were brushed separately. The paper, when dry, is quite light and transparent, and may readily be written on with ink.

Transfer paper.—This is useful for copying patterns, drawings, etc. Designs for scroll saws may be copied very neatly by means of it. It is easily made by rubbing a thin but tough unglazed paper with a mixture of lard and lampblack. The copy is made by laying a sheet of the transfer or, as it is sometimes called, *manifold* paper, over a clean sheet of drawing or writing paper, and over it the drawing to be copied. The lines of the drawing are then carefully traced with a fine but blunt point, and the pressure along the lines transfers to the clean paper underneath a perfect copy. To keep the under side of the drawing or pattern clean, a sheet

of tissue paper may be placed between it and the transfer paper.

Water Stains, To Remove from Engravings or Paper.—Fill a large vessel with pure water and dip the engraving in, waving it backward and forward until thoroughly wet. Then spread a sheet of clean white paper on a drawing board, lay the engraving on it and fasten both to the board with drawing pins. Expose it to bright sunshine, keeping it moist until the stains disappear, which will not be long. This is simply a modification of the old system of bleaching linen.

Waxed Paper.—Paper saturated with wax, paraffin or stearin is very useful for wrapping up articles which should be kept dry and not exposed to the air. Place a sheet of stout paper on a heated iron plate, and over this place the sheets of unglazed paper—tissue paper does very well—that are to be waxed. Enclose the wax or paraffin in a piece of muslin, and as it melts spread it evenly over the paper.

Patina.

An imitation of patina for bronze objects of all kinds can be produced by preparing a paint of carbonate of copper and any light alcoholic varnish, and applying it to the object with a brush. This green color penetrates the smallest recesses, and has, when dry, the appearance of patina. Carbonate of copper gives a blue patina, verdigris a light green, and intermediate shades of color can be obtained by mixing the two.

Patterns—To Trace.

There are various methods of making copies of patterns on paper, the simplest perhaps being the use of the tracing paper described on another page.

When a few duplicates of patterns for embroidery are required, they may be very easily made by hand as follows:

The drawing is made upon paper; then lay the drawing upon an even cloth, and perforate all the lines with a fine needle, close and even. Then take finely powdered charcoal, three parts, resin one part in fine powder; mix and tie it in a piece of porous calico, so that it forms a dusting bag. Lay the perforated drawing upon your material, hold down with one hand, rub the dusting-bag over the drawing; the dust will fall through the holes and form the drawing on the material. Remove the paper drawing, lay blotting-paper over

the dust pattern, and go over it with a warm flat iron The heat will melt the resin and fix the drawing on the material.

Pencils as a Substitute for Ink.

Aniline pencils have been in use for some time, and have given good satisfaction, but the following is said to give even better results. Pencils made after the following formula give a very black writing, capable of being reproduced by the copying machine, and which does not fade on exposure to light. The mass for these pencils is prepared as follows: 10 pounds of the best logwood are repeatedly boiled in 10 gallons of water, straining each time. The liquid is then evaporated down till it weighs 10 pounds, and is then allowed to boil in a pan of stoneware or enamel. To the boiling liquid, nitrate of oxide of chrome is added in small quantities, until the bronze-colored precipitate formed at first is redissolved with a deep blue coloration. This solution is then evaporated in the water bath down to a sirup, with which is mixed well kneaded clay in the proportion of 1 part of clay to 3½ of extract. A little gum tragacanth is also added to obtain a proper consistence.

It is absolutely necessary to use the salt of chrome in the right proportion. An excess of this salt gives a disagreeable appearance to the writing, while if too little is used the black matter is not sufficiently soluble.

The other salts of chrome cannot be used in this preparation, as they would crystallize, and the writing would scale off as it dried.

The nitrate of oxide of chrome is prepared by precipitating a hot solution of chrome alum with a suitable quantity of carbonate of soda. The precipitate is washed till the filtrate is free from sulphuric acid. The precipitate thus obtained is dissolved in pure nitric acid, so as to leave a little still undissolved. Hence the solution contains no free acid, which would give the ink a dirty red color. Oxalic acid and caustic alkalies do not attack the writing. Dilute nitric acid reddens, but does not obliterate the characters.

Pencil Marks—To Fix.

To fix Pencil Marks so they will not rub out, take well-skimmed milk and dilute with an equal bulk of water. Wash the pencil marks (whether writing or drawing) with

this liquid, using a soft, flat camel-hair brush, and avoiding all rubbing. Place upon a flat board to dry.

Pewter.

The principal constituents of pewter are lead and tin ; the proportions of the two metals depending somewhat on the use to which the alloy is put. The best contains but 16 to 20 per cent. of lead. Of this plates and dishes are made, which look like block tin, and can be brightly polished by rubbing. The addition of more lead cheapens the commodity, and gives it a dull bluish appearance. In France pewter vessels for wine and vinegar contain 18 per cent. of lead. It has been found that a larger proportion of that metal in utensils for this purpose is liable to result in the formation, in the liquid, of the poisonous acetate or sugar of lead.

A little copper added in making pewter hardens the compound and renders it sonorous, so that toy trumpets and other rude musical instruments can be made of it. If the copper is replaced by antimony, hardness and a silvery lustre are the result. If the contents of the melting pot are stirred with a strip half of zinc and half of tin, or if a lump of zinc is allowed to float on the melted metal during the casting, the vaporized spelter seems to protect the fluid mass from oxidation, and prevents the formation of dross. Hence it is said to " cleanse " the mass.

Jewellers use polishers and laps of pewter, and sheets of the article are to some extent used for cheap engraving, music notes, or other figures being stamped upon it instead of being cut with a burin or graver. The ease with which it melts causes it to be employed by tinsmiths and tinkers for solder. Care must be taken not to set pewter dishes, mugs, spoons, lamps, etc., on stoves or other hot bodies, as, if left for any time, they are liable to settle into shapeless lumps.

Pillows for the Sick Room.

Save all your scraps of writing paper, old envelopes, old notes of no use for keeping, old backs of notes, etc. Cut them in strips about one-half inch wide and two inches long, and curl them well with an old penknife. Make a pillow case of any materials you have ; fill it with your curled paper mixed with a few shreds of flannel. Stuff it quite full, sew up the end and cover as you please, These pillows are invaluable

in cases of fever, as they keep constantly cool and allow a circulation of air.

Plaster of Paris.

Plaster of Paris is a well known material, obtained by exposing the purer varieties of gypsum or alabaster to a heat a little above that of boiling water, when it becomes a fine, white dry powder. Sometimes the gypsum is first reduced to a fine powder and then heated in iron pans, and in this case the operation is sometimes called "boiling" plaster, because the escape of the water, with which crystalline gypsum is always combined, gives to the fine powder the appearance of *boiling.* Plaster of Paris, after being boiled, rapidly deteriorates when exposed to the air, consequently when plaster is required for making cements or for other purposes for which a good article is needed, care must be taken to secure that which is good and freshly boiled. The Italian image makers always use a superior quality of plaster, and it may generally be obtained from them in small quantity.

The employment of gypsum in casting, and in all cases where impressions are required, is very extensive. A thin pulp of 1 part gypsum and 2½ parts water is made ; this pulp hardens by standing. The hardening of good, well-burnt gypsum is effected in one to two minutes, and more quickly in a moderate heat. Models are made in this substance for galvano-plastic purposes, for metallic castings, and for ground works in porcelain manufacture. The object from which the cast is to be taken is first well oiled to prevent the adhesion of the gypsum. When greater hardness is required a small quantity of lime is added ; this addition gives a very marble-like appearance, and the mixture is much employed in architecture, being then known as gypsum-marble or stucco. The gypsum is generally mixed with lime water, to which sometimes a solution of sulphate of zinc is added, After drying, the surface is rubbed down with pumice stone, colored to represent marble, and polished with Tripoli and olive oil. Artificial scagliola work is largely composed of gypsum.

There are several methods of hardening gypsum. One of the oldest consists in mixing the burnt gypsum with lime-water or a solution of gum arabic. Another, yielding very good results, is to mix the gypsum with a solution of 20

ounces of alum in 6 pounds of water ; this plaster hardens completely in 15 to 30 minutes, and is largely used under the name of marble cement. Parian cement is gypsum hardened by means of borax, 1 part borax being dissolved in 9 parts of water, and the gypsum treated with the solution. Still better results are obtained by the addition to this solution of 1 part of cream of tartar.

The hardening of gypsum with a water-glass solution is found difficult, and no better results are obtained than with ordinary gypsum. Fissot obtains artificial stone from gypsum by burning and immersions in water, first for half a minute, after which it is exposed to the air and again for two to three minutes, when the block appears as a hardened stone. It would seem from this method that the augmentation in hardness is due to a new crystalization. Hardened gypsum, treated with stearic acid or with paraffine, and polished, much resembles meerschaum ; the resemblance may be increased by a coloring solution of gamboge and dragon's blood, to impart a faint red-yellow tint. The cheap artificial meerschaum pipes are manufactured by this method.

Poisons.

Many of the substances used in the arts are highly poisonous. Indeed, some of the most virulent poisons are employed in very common operations. Thus arsenic is used for coloring brass ; the strong acids are used in every machine shop and foundry, and even prussic acid may be occasionally produced during the employment of prussiate of potash. The extremely poisonous cyanide of potassium is used by every photographer and electroplater. Even into the household, poisons too frequently find their way. Our matches are tipped with a strong poison, and housekeepers are often too ready with poison for the destruction of vermin. Phosphorous, arsenic and corrosive sublimate, are too frequently thus used. Paris green also we have actually seen used for the destruction of cockroaches in pantries, and corrosive sublimate is in common use as a poison for bed-bugs. As a bug poison it is generally dissolved in alcohol or whiskey, and the odor and taste have sometimes proved a strong temptation to persons who did not fully realize its dangerous character. All bottles containing such mixtures should therefore be carefully labelled, "POISON," in large letters,

and when emptied they should either be broken, or very carefully cleansed, since accidents have arisen from careless persons pouring drinkable liquids into bottles that have contained solutions of corrosive sublimate, which solutions, after drying up have left the bottle apparently empty, but in reality containing an amount of poison sufficient to destroy several lives.

In all cases where poisons have been swallowed, the proper course is first to neutralize the deleterious agent, and then to procure its rejection by means either of the stomach-pump or an emetic. The stomach-pump is, of course, the best and most expeditious agent. It requires but a few moments to insert it and remove the contents of the stomach; fresh supplies of water and the proper antidotes can then be poured into the organ, so that in a few minutes the last traces of the poison can be removed. But as the stomach-pump is to be found in the possession of physicians only, reliance must in general be placed upon emetics, of which the best is, unquestionably, mustard—an article which is to be found in almost every household. It is generally conceded by physicians that mustard is the mildest, most rapid, and most efficient emetic known. It is prepared for use as follows: Take about a plump dessert-spoonful of genuine flour of mustard (if it be mixed with wheat flour or turmeric, more will be needed), and mix it rapidly in a cup with water to the consistency of thin gruel, and let this be swallowed without delay or hesitation. In a very few seconds the contents of the stomach will be ejected. Before the emetic action has entirely ceased, a little lukewarm water, or still better, warm milk, should be forced down. This will be thrown off immediately, and will serve to rinse out the stomach and remove the last traces of deleterious matter.

By the time the operation of the emetic has ceased, a physician will probably be in attendance, and to his care the patient should be at once confided.

The following notes on special poisons will prove useful:

Strong Acid.—Where nitric, sulphuric or hydrochloric acid has been swallowed, it is well to administer carbonate of soda before giving the emetic.

Oxalic Acid.—This acid is often found among the articles provided for household use, being used for cleaning brass and various metals, as well as for removing stains of ink and

iron mould. In former times it was used for cleaning boot tops and for some other purposes. In appearance it resembles epsom salts so closely that even experienced chemists might be deceived, if it were not for the taste, for while the acid is intensely sour the salts are as intensely bitter.

The proper antidote to oxalic acid is some form of lime, and the best method of administering it is to mix finely pulverized chalk with water to the consistency of cream and swallow it. It is a singular fact that when oxalic acid is largely diluted with water, it acts very rapidly and energetically, destroying life almost with the rapidity of prussic acid. Hence to administer soapy water, or any other very diluted remedy, would be almost fatal. And yet this course was actually recommended by a popular scientific journal.

Prussic Acid.—As this is one of the most rapid of all poisons in its action, prompt and energetic measures are demanded. Cold affusion to the head and spine has been found the most efficacious mode of treatment. Internal remedies appear to be of no service. The vapor of ammonia may be cautiously applied to the nostrils, and stimulating liniments by friction to the chest and abdomen, but unless the dose is small, and the patient is seen early, there can be little hope of benefit from any treatment. Certain chemical substances (cyanides) from which prussic acid is slowly evolved by the action of the air, are used in electro-plating and in photography. These substances are themselves very strong poisons, and if accidentally swallowed they cause death with such rapidity that there is scarcely any time to apply any remedies. Green copperas (sulphate of iron) dissolved in water and administered would decompose and neutralize the poison, after which the directions given for prussic acid should be followed. When poisoning occurs from breathing the vapors arising from these salts, it is caused by prussic acid, and should be treated accordingly.

Arsenic—Paris Green.—By *arsenic* is generally meant the white oxide of the metal arsenic. It is also known as *arsenious* acid. Paris green is well known and owes its deadly properties to arsenic. In all cases in which poisonous doses of arsenic have been swallowed, our great dependance must be placed upon emetics and purgatives. Persons who take arsenic upon a full stomach frequently escape its effects, and therefore it is always well to give copious draughts of milk,

or, if more convenient, raw eggs, beaten up. Then, as soon as possible, administer an emetic (mustard is as good as any) and keep up its action by giving milk during the intervals of the paroxysms of vomiting. When the stomach no longer rejects what is swallowed, give a good dose of castor oil.

Corrosive Sublimate.—When corrosive sublimate has been swallowed, the first thing to be done is, if possible, to get rid of it, either by means of emetics or the stomach-pump. If the poison has been taken on a full stomach, an emetic or the pump is the first thing in order ; if the stomach be empty, it will be better to administer, in the first place, as much white of egg, or milk, or mixture of both, as the patient can be made to swallow, and immediately afterwards give an emetic. The white of eggs is the great antidote for corrosive sublimate, but it is of no use where the poison has been absorbed into the system, and if, after administering white of eggs, we neglect to procure its rejection, the compound that is formed may be destroyed by the action of the gastric juice, and left free to act with all its original virulence.

Phosphorous.—There is no efficient antidote or remedy for poisoning by phosphorous. Taylor recommends the administration of emetics, and of albuminous or mucilaginous drinks, holding hydrate of magnesia suspended. The exhibition of oil would be decidedly injurious, as this dissolves and tends to diffuse the poison. Saline purgatives should therefore be preferred.

Opium.—When a poisonous dose of opium has been taken, the first object should be to remove the poison, and this must freqnently be accomplished by the stomach-pump, as emetics are of little service when the patient has lost the power of swallowing. Dashing cold water on the head, chest, and spine, has been adopted with great success ; in the treatment of infants, the plunging of the body into a warm bath, and suddenly removing it from the water into the cold air, has been found a most effectual method of rousing them. Severe whipping on the palms of the hands and soles of the feet or the back has also been successfully employed. A common plan for rousing an adult is to keep him in continual motion, by making him walk between two assistants. Above all things, the tendency to fall into a state of lethargy must be prevented. A strong decoction of coffee has been frequently employed as a stimulant to promote recovery, and apparently with benefit.

Strychnine.—When this poison has been absorbed and conveyed into the blood there is no known antidote to its action. But if spasms have not already set in so as to close the jaws, we should, by the stomach-pump or by emetics, endeavor to remove the poison. In a case in which six grains of strychnine were taken, the life of the person appears to have been saved by the early use of the stomach-pump. It has been supposed that emetics would not act in these cases ; but this is an error based on imperfect observation. In one case a man took three grains of strychnine, dissolved in rectified spirits and diluted sulphuric acid. He went to bed and slept for about an hour and a half, when he awoke in a spasm, uttering loud cries, which alarmed the household. Free vomiting was brought on by the use of emetics, and this, combined with other treatment, led to his recovery. The first step, therefore, in every case, should be to induce vomiting.

Ivy Poisoning.—The best remedy for ivy poisoning is said to be sweet spirits of nitre. Bathe the parts affected freely with this fluid three or four times during the day, and the next morning scarcely any trace of poison will be found. If the blisters be broken, so as to allow the spirits to penetrate the cuticle, a single application will be sufficient.

Stings.—Extract the sting, which is always left behind by bees, and bathe the parts with cold water, or apply a good poultice of common clay mud. Liquid ammonia mixed either with the water or the mud, will prove of service. All liniments which require rubbing are bad, as tending to irritate the part and diffuse the poison. Above all, avoid scratching the wound.

Polishing Powders.

Nothing is more necessary to the successful use of polishing powder than *equality* in the grain. Fine dust clogs the action of coarse grinding powders, and prevents them from cutting with rapidity the object to be ground ; coarse particles mixed with fine polishing powder scratch the article to be polished, and render grinding and polishing necessary again. To secure fineness and uniformity no process equals that of elutriation, which is thus performed : Suppose it were desired to separate the ordinary flour of emery into three different degrees of fineness. Take three vessels (such as tin pails or glass jars) and mix the emery with a large

quantity of water—say a quart of water to 1½ oz. of emery. Stir the mixture until the emery is thoroughly diffused through the liquid, and allow to stand five minutes. By this time all the heavier particles will have settled, and on pouring the fluid into a second jar only the finer portion will be carried over. So continue to wash the first residuum until nearly all the particles have subsided at the end of five minutes, and the water is left comparatively clear. You will now have the coarse portion, No. 1, by itself.

So, from the sediment collected from the washings of No. 1, you may collect a portion, No. 2, having a second degree of coarseness. The last and finest will be obtained by letting the final washings stand ten or fifteen minutes, pouring off the liquid and allowing it to settle.

The principal polishing powders are chalk or whiting, crocus or rouge, emery, oilstone powder, and putty or tutty, which latter consists chiefly of oxide of tin. Other powders, such as tripoli, bath-brick, sand, etc., are rarely used for the finer kinds of work. Emery is so well known that it does not need description.

Chalk or Whiting.—Chalk is a native carbonate of lime, consisting of the remains of minute creatures known as *foraminifera*, and when simply scraped or crushed under a hammer or runner, it is sometimes used for polishing such soft substances as bone, ivory, etc. As it contains particles of silica of varying size, it cuts freely, but is apt to scratch. To remove the gritty particles, the chalk is ground, and the finer parts separated by washing. It then becomes *whiting*, which is generally sold in lumps. Whiting has very poor cutting qualities, and it is therefore used chiefly as *plate powder* for cleaning gold, silver, glass, etc., and for absorbing grease from metals which have been polished by other means.

Prepared Chalk.—This is a manufactured article, prepared by adding a solution of carbonate of soda to a solution of chloride of calcium (both cheap salts), so long as a precipitate is thrown down. The solutions should be carefully filtered through paper before being mixed, and dust should be rigorously excluded. The white powder which falls down is carbonate of lime, or chalk, and when carefully washed and dried, it forms a most excellent polishing powder for the softer metals. The particles are almost impalpable,

but seem to be crystalline, for they polish quickly and smoothly, though they seem to wear away the material so little that its form or sharpness is not injured to any perceptible degree.

Crocus or Rouge.—These articles are manufactured at Liverpool, by persons who make it their sole occupation, in the following manner :

They take crystals of sulphate of iron (green vitriol or copperas), immediately from the crystallizing vessels, in the copperas works there, so as to have them as clean as possible ; and instantly put them into crucibles or cast iron pots, and expose them to heat, without suffering the smallest particle of dust to get in, which would have a tendency to scratch the articles to be polished. Those portions which are least calcined and are of a scarlet color, are fit to make rouge for polishing gold or silver, while those which are calcined or have become red-purple or bluish-purple, form crocus fit for polishing brass or steel. Of these, the bluish-purple colored parts are the hardest, and are found nearest to the bottom of the vessels, and consequently have been exposed to the greatest degree of heat.

Mr. Andrew Ross's mode of preparing Oxide of Iron.—Dissolve crystals of sulphate of iron in water ; filter the solution to separate some particles of silex which are generally present, and sometimes are abundant ; then precipitate from this filtered solution the protoxide of iron, by the addition of a saturated solution of soda, which must also be filtered. This grey oxide is to be repeatedly washed and then dried ; put it in this state into a crucible, and very gradually raise it to a dull red heat ; then pour it into a clean metal or earthen dish, and while cooling it will absorb oxygen from the atmosphere, and acquire a beautiful dark red color. In this state it is fit for polishing the softer metals, as silver and gold, but will scarcely make any impression on hardened steel or glass. For these latter purposes I discovered that it is the black oxide that affected the polish (and this gives to the red oxide a purple hue, which is used as the criterion of its cutting quality in ordinary), therefore for polishing the harder materials the oxide must be heated to a bright red, and kept in that state until a sufficient quantity of it is converted into black oxide to give the mass a deep purple hue when exposed to the atmosphere. I have

converted the whole into black oxide; but this is liable to scratch, and does not work so pleasantly as when mixed with the softer material. The powder must now be levigated with a soft wrought iron spatula, upon a soft iron slab, and afterwards washed in a very weak solution of gum arabic, as recommended by Dr. Green in his paper on specula. The oxide prepared in this manner is almost impalpable, and free from all extraneous matter, and has the requisite quality in an eminent degree for polishing steel, glass, the softer gems, etc.

Lord Ross's Mode of preparing the Peroxide of Iron.—"I prepare the peroxide of iron by precipitation with water of ammonia from a pure dilute solution of sulphate of iron; the precipitate is washed, pressed in a screw press till nearly dry, and exposed to a heat which in the dark appears a dull low red. The only points of importance are, that the sulphate of iron should be pure, that the water of ammonia should be decidedly in excess, and that the heat should not exceed that I have described. The color will be a bright crimson inclining to yellow. I have tried both soda and potash, pure, instead of water of ammonia, but after washing with some degree of care, a trace of the alkali still remained, and the peroxide was of an ochrey color till overheated, and did not polish properly."

Oilstone Powder.—The Turkey oilstone can hardly be considered as a hone slate, having nothing of a lamellar or schistose appearance. As a whetstone it surpasses every other known substance, and possesses, in an eminent degree, the property of abrading the hardest steel, and is, at the same time, of so compact and close a nature as to resist the pressure necessary for sharpening a graver or other small instrument of that description. Little more is known of its natural history than that it is found in the interior of Asia Minor, and brought down to Smyrna for sale. The white and black varieties of Turkey oilstone differ but little in their general characters; the black is, however, somewhat harder, and is imported in larger pieces than the white.

Fragments of oilstone, when pulverized, sifted and washed, are much in request by mechanicians. This abrasive is generally preferred for grinding together those fittings of mathematical instruments and machinery, which are made wholly or in part of brass or gun metal, for oilstone being

softer and more pulverulent than emery, is less liable to become embedded in the metal than emery, which latter is then apt continually to grind, and ultimately damage the accuracy of the fittings of brass works. In modern practice it is usual, however, as far as possible, to discard the grinding together of surfaces, with the view of producing accuracy of form, or precision of contact.

Oilstone powder is preferred to pumice-stone powder for polishing superior brass works, and it is also used by the watchmaker on rubbers of pewter in polishing steel.

Pumice-stone Powder.—Pumice-stone is a volcanic product, and is obtained principally from the Campo Bianco, one of the Lipari islands, which is entirely composed of this substance. It is extensively employed in various branches of the arts, and particularly in the state of powder, for polishing the various articles of cut glass ; it is also extensively used in dressing leather, and in grinding and polishing the surface of metallic plates, etc.

Pumice-stone is ground or crushed under a runner, and sifted, and in this state it is used for brass and other metal works, and also for japanned, varnished and painted goods, for which latter purposes it is generally applied on woolen cloths with water.

Putty Powder is the pulverized oxide of tin, or generally of tin and lead mixed in various proportions. The process of manufacture is alike in all cases—the metal is oxidized in an iron muffle, or a rectangular box, close on all sides, except a square hole in the front side. The retort is surrounded by fire, and kept at a red heat, so that its contents are partially ignited, and they are continually stirred to expose fresh portions to the heated air ; the process is complete when the fluid metal entirely disappears, and the upper part of the oxide then produced, sparkles somewhat like particles of incandescent charcoal. The oxide is then removed with ladles, and spread over the bottom of large iron cooling pans and allowed to cool. The lumps of oxide which are as hard as marble, are then selected from the mass and ground dry under the runner ; the putty powder is afterwards carefully sifted through lawn.

As a criterion of quality it may be said that the whitest putty powder is the purest, provided it be heavy. Some of the common kinds are brown and yellow, while others, from

the intentional admixture of a little ivory black, are known as *grey putty*. The pure white putty which is used by marble workers, opticians and some others, is the smoothest and most cutting ; it should consist of the oxide of tin alone, but to lessen the difficulty of manufacture, a very little lead (the linings of tea chests), or else an alloy called *shruff* (prepared in ingots by the pewterers) is added to assist the oxidation.

The putty powder of commerce of good fair quality, is made of about equal parts of tin and lead, or tin and shruff; the common dark colored kinds are prepared of lead only, but these are much harsher to the touch, and altogether inferior.

Perhaps the most extensive use of putty powder, is in glass and marble works, but the best kind serves admirably as plate powder, and for the general purposes of polishing.

Putty powder for fine optical purposes is prepared by Mr. A. Ross by the following method, which is the result of many experiments. Metallic tin is dissolved in nitro-muriatic acid, and precipitated from the filtered solution by liquid ammonia, both fluids being largely diluted with water. The peroxide of tin is then washed in abundance of water, collected in a cloth filter, and squeezed as dry as possible in a piece of new clean linen ; the mass is now subjected to pressure in a screw-press, or between lever boards, to make it as dry as possible. When the lump thus produced has been broken in pieces and dried in the air, it is finally levigated while dry on a plate of glass with an iron spatula, and afterwards exposed in a crucible to a *low* white heat.

Before the peroxide has been heated, or while it is in the levigated *hydrous* state, the putty powder possesses but little cutting quality, as under the microscope, the particles then appear to have no determined form, or to be *amorphous*, and, on being wetted, to resume the gelatinous condition of the hydrous precipitate, so as to be useless for polishing ; whereas, when the powder is heated, to render it *anhydrous*, most of the particles take their natural form, that of *lamellar crystals*, and act with far more energy (yet without scratching) than any of the ordinary polishing powders. The whole mass requires to be washed or elutriated in the usual manner after having been heated, in order to separate the coarser particles.

Mr. Ross usually adds a little crocus to the putty powder by way of coloring matter, as it is then easier to learn the quantity of powder that remains on the polishing tool, and it may be added that this is the polishing powder employed by Mr. Ross in making his improved achromatic object-glasses for astronomical telescopes.

Vienna Lime.—Vienna lime and alcohol give a beautiful polish to iron or steel. Select the soft pieces of lime, such as will be easily crushed by the thumb and finger, as they are the most free from gritty particles. Apply with a cork, piece of soft pine wood, leather, chamois, etc.

Resins.

The resins are so frequently employed in the arts that a knowledge of the action of different solvents upon them is of great value.

Dr. Sac, of Neuenberg, Switzerland, has made an extensive inquiry into the nature of different resins. The following results, as obtained by him, are given in Dingler's *Polytechnic Journal* :—The resins spoken of are copal, amber, dammar, common resins, shellac, elemi, sandarach and mastic. All these resins can be reduced to powder.

The following will become pasty before melting : Amber, shellac, elemi, sandarach and mastic ; the others will become liquid at once.

In boiling water common resin will form a semi-fluid mass ; dammar, shellac, elemi and mastic will become sticky ; while copal, amber and sandarach will remain unchanged.

Dammar and amber do not dissolve in alcohol ; copal becomes pasty ; elemi dissolves with difficulty, while resin, shellac, sandarach and mastic dissolve easily.

Acetic acid makes common resin swell ; on all the others it has no effect.

Caustic soda dissolves shellac readily ; resin partly ; but has no influence on the others.

Amber and shellac do not dissolve in sulphide of carbon ; copal becomes soft and expands ; elemi, sandarach and mastic dissolve slowly ; while resin and dammar dissolve easily.

Oil of turpentine dissolves neither amber nor shellac, but swells copal ; dissolves dammar, resin, elemi and sandarach easily, and mastic very easily.

Benzol does not dissolve copal, amber and shellac, but

does elemi and sandarach to a limited extent; while dammar, resin and mastic offer no difficulty.

Petroleum ether has no effect on copal, amber and shellac; it is a poor solvent for resin, elemi and sandarach, and a good one for dammar and mastic.

Concentrated sulphuric acid dissolves all resins, imparting to them a dark brown color, excepting dammar, which takes a brilliant red tint.

Boiling linseed oil has no effect on copal and amber; shellac, elemi and sandarach dissolve easily.

Nitric acid imparts to elemi a dirty yellow color; to mastic and sandarach a light brown; it does not affect the others.

Ammonia is indifferent to amber, dammar, shellac (?) and elemi; copal, sandarach and mastic become soft, and finally dissolve; while resin will dissolve at once.

Saws.

The grand secret of putting any saw in the best possible cutting order, consists in filing the teeth at a given angle to cut rapidly, and of a uniform length, so that the points will all touch a straight-edged rule without showing a variation of a hundredth part of an inch. Besides this, there should be just enough set in the teeth to cut a kerf as narow as it can be made, and at the same time allow the blade to work freely without pinching. On the contrary, the kerf must not be so wide as to permit the blade to rattle when in motion. The very points of the teeth do the cutting. If one tooth is a twentieth of an inch longer than two or three on each side of it, the long tooth will be required to do so much more cutting than it should, that the sawing cannot be done well. Hence the saw goes jumping along, working hard and cutting slowly. If one tooth is longer than those on either side of it, the short ones do not cut, although the points may be sharp. When putting a cross-cut saw in order, it will pay well to dress the points with an old file, and afterwards sharpen them with a fine whetstone. Much mechanical skill is requisite to put a saw in prime order. One careless thrust with a file will shorten the point of a tooth so much that it will be utterly useless, so far as cutting is concerned. The teeth should be set with much care, and the filing should be done with great accuracy. If the teeth are uneven at the points a large flat file should be secured to a block of wood

in such a manner that the very points only may be jointed, so that the cutting edge of the same may be in a complete line or circle. Every tooth should cut a little as the saw is worked. The teeth of a handsaw, for all sorts of work, should be filed fleaming, or at an angle on the front edge; while the back edges may be filed fleaming, or square across the blade. The best way to file a circular saw for cutting wood across the grain, is to dress every fifth tooth square across and about one-twentieth of an inch shorter than the others, which should be filed fleaming at an angle of about forty degrees.

Sieves.

It is often desirable to sift powders into different degrees of fineness, and very fine sieves are not always to be easily had. Those made of hair and wire answer well, but the finest may be made out of the bolting cloth used by millers. It may be sewed over a hoop of tin or brass, or even a ring made of iron wire, or a piece of flexible wood bent into form may answer to hold the cloth.

Shellac.

Shellac or lac is a resinous substance which, in India, flows from certain trees in the form of lucid tears, in consequence of punctures made upon their branches by a small insect.

It is found in commerce in three forms—*stick lac*, *seed lac* and *shellac*. Stick lac is the substance in its natural state investing the small twigs of the trees, which are generally broken off in collecting it. When separated from the twigs and partially cleansed it is known as *seed lac*. Shellac is the seed lac after it has been melted, purified and formed into thin cakes.

Shellac is very apt to be adulterated with common resin, and hence, unless when a pale lacquer is required, most artisans prefer seed lac. When lac is mixed with a little resin and colored with vermillion or ivory black it forms sealing wax.

Shellac is soluble in alcohol but not in turpentine. It is also soluble in alkaline solutions, including ammonia. A solution of borax in water dissolves it readily, and the resulting solution has been used as a cement, as a varnish, and as a

basis for indelible ink. It is much used by hatters as an insoluble cement.

Clarifying Shellac Solutions.—Much trouble is generally experienced in obtaining clear solutions of shellac. If a mixture of 1 part shellac with 7 parts of alcohol of 90 per cent. is heated to a suitable temperature, it quickly clears, but as quickly becomes turbid again on cooling. The only practical method of freeing the solution from what some writers call "wax," and others "fatty acid," which is present in shellac in the proportion of 1 to 5 per cent., and is the cause of the turbidity, has hitherto been the tedious process of repeated filtration. M. Peltz recommends the following method: Shellac 1 part is dissolved in alcohol 8 parts, and allowed to stand for a few hours. Powdered chalk is then added in quantity equal to half the weight of shellac in the solution, and the latter is heated to 60° R. The greater portion of the solution clears rapidly, and the remainder may be clarified by once filtering. Carbonate of magnesia and sulphate of baryta were tried in the same way, but were not found equally efficacious.

Bleached Shellac.—When bleached by the ordinary process, shellac affords a polish for light woods, etc., that is brittle and liable to peel off, while the presence of a trace of chlorine causes metallic inlaying to become dim. These defects may be avoided by a different mode of bleaching, namely, by adding fine granulated bone-black to the solution of shellac in 90 per cent. alcohol, until a thin, pasty mass is formed, and exposing this for several days to direct sunlight, occasionally shaking it thoroughly and filtering when sufficiently bleached.

Silver.

Pure silver is quite soft, and is, therefore, generally alloyed with copper to harden it.

Silversmiths' work, after having been filed is generally rubbed, firstly, with a lump of pumice-stone and water; secondly, with a slip of water-of-Ayr stone and water; thirdly, a revolving brush with rottenstone and oil; fourthly, an old black worsted stocking with oil and rottenstone, and fifthly, it is finished with the hand alone, the deep black lustre being given with rouge of great fineness. The corners

and edges are often burnished with a steel burnisher, which is lubricated with soap and water if at all.

In this case and in all others of polishing with the naked hand, it is generally found that women succeed better than men, and that some few, from the peculiar texture and condition of the skin, greatly excel in the art of polishing. The skin should be soft and very slightly moist, as the polishing powder then attaches itself conveniently, and there is just sufficient adhesion between the hand and work to make the operation proceed rapidly. A dry hand becomes hard and horny, and is liable to scratch the work, and excess of moisture is also objectionable, as the hand is then too slippery.

The plated reflectors for light-houses are cleaned with rouge, which is dusted on from a muslin bag, and rubbed over them with a clean dry wash-leather.

A thin film of oxide will nevertheless occasionally form on the surface of the reflector, and this is removed with a piece of leather, with rouge moistened with spirits of wine, which dissolves the oxide, after which the dry rubber is applied as above.

Oxidized Silver.—This is not an oxidization, but a combination with sulphur or chlorine. Sulphur, soluble sulphides, and hydrosulphuric acid blacken silver, and insoluble silver salts, and particularly the chloride of silver, rapidly blackens by solar light. Add four or five thousandths of hydrosulphate of ammonia, or of quintisulphide of potassium, to ordinary water at a temperature of 160° to 180° Fahr. When the articles are dipped into this solution an iridescent coating of silver sulphide covers them, which, after a few seconds more in the liquid, turns blue-black. Remove, rinse, scratch-brush, and burnish when desired. Use the solution when freshly prepared, or the prolonged heat will precipitate too much sulphur, and the deposit will be wanting in adherence ; besides, the oxidization obtained in freshly-prepared liquors is always brighter and blacker than that produced in old solutions, which is dull and grey. If the coat of silver is too thin, and the liquor too strong, the alkaline sulphide dissolves the silver, and the underlying metal appears. In this case cleanse and silver again, and use a weaker blackening solution. Oxidized parts and gilding may be put upon the same article by the following method : After the whole surface has been gilt certain portions are covered with the resist varnish ;

silver the remainder. Should the process of silvering by paste and cold rubbing be employed, the gilding should be very pale, because it is not preserved, and is deeply reddened by the sulphur liquor. When this inconvenience occurs from a too concentrated liquor, it is partly remedied by rapidly washing the article in a tepid solution of cyanide of potassium.

A very beautiful effect is produced upon the surface of silver articles, technically termed oxidizing, which gives the surface an appearance of polished steel. This can be easily effected by taking a little chloride of platinum, heating the solution and applying it to the silver where an oxidized surface is required, and allowing the solution to dry upon the silver. The darkness of the color produced varies according to the strength of the platinum solution from a light steel gray to nearly black. The effect of this process, when combined with what is termed dead work, is very pretty, and may be easily applied to medals, and similar objects.

The high appreciation in which ornaments in oxidized silver are now held, renders a notice of the following processes interesting. There are two distinct shades in use—one produced by a chloride and which has a brownish tint, and the other produced by sulphur, which has a bluish-black tint. To produce the former it is necessary to wash the article with a solution of sal ammoniac; a much more beautiful tint may, however, be obtained by employing a solution composed of equal parts of sulphate of copper and sal ammoniac in vinegar. The fine black tint may be produced by a slightly warm solution of sulphuret of potassium or sodium.

The chloride of platinum mentioned above is easily prepared as follows: Take 1 part nitric acid and 2 parts hydrochloric (muriatic) acid; mix together and add a little platinum; keep the whole at or near a boiling heat; the metal is soon dissolved, forming the solution required.

Old Silvering.—To imitate old artistic productions made of solid silver, the groundwork and hollow portions not subject to friction are covered with a blackish-red earthy coat, the parts in relief remain with a bright lead lustre. Mix a thin paste of finely powdered plumbago with essence of turpentine, to which a small portion of red ochre may be added to imitate the copper tinge of certain old silverware;

smear this all over the articles. After drying, gently rub with a soft brush, and the reliefs are set off by cleaning with a rag dipped in spirits of wine.

To give the old silver tinge to small articles, such as buttons and rings, throw them into the above paste, rub in a bag with a large quantity of dry boxwood sawdust until the desired shade is obtained.

Cleaning Silver.—Silver being a comparatively soft metal, should never be rubbed with polishing powders capable of cutting or grinding, as the delicate surface, especially if engraved or ornamented, will be sure to have the delicate lines and work injured. In cleaning silver there are but two things that ever require to be removed—dirt and the sulphuret of silver. The latter appears as a coating on all silver articles exposed to the air, and especially on silver spoons etc., which have come in contact with sulphur or the yolk of eggs. Sulphuret or sulphide of silver is soluble in several salts, especially cyanide of potassium, hyposulphite of soda, and several salts of ammonia. Therefore, to clean silver which has been blackened with sulphur, the best plan is to dissolve off the sulphide by means of some of the chemicals named.

For the ordinary purposes of cleansing silver the best material is a thin paste of alcohol, 2 parts ; ammonia, 1 part ; and whiting enough to make a liquid like cream. This should be smeared or painted over the silver and allowed to stand until dry. If then brushed off with a very fine brush the silver will appear clear and bright. The alcohol and ammonia dissolve all dirt and sulphide, which are then absorbed by the whiting and removed with it.

Where really good whiting, that is to say, an article that is soft or free from grit, cannot be procured, starch may be used.

Ink Stains, To Remove from Silver—The tops and other portions of silver inkstands frequently become deeply discolored with ink, which is difficult to remove by ordinary means. It may, however, be completely eradicated by making a little chloride of lime into a paste with water, and rubbing it upon the stains.

To Dissolve the Silver off old Plated Goods.—Mix 1 oz. of finely powdered saltpetre with 10 oz. sulphuric acid, and steep the goods in this mixture. If diluted with water it acts on copper and other metals, but if very strong it dis-

solves the silver only, and may be used to dissolve silver off plated goods without affecting the other metals.

Silvering.

Leather, cloth, wood and similar materials are silvered by processes similar to those used for gilding, silver leaf being substituted for gold leaf. Metals may be silvered either by brazing a thin sheet of silver to the surface, or by electro-plating. Frequently, however, it is desired to lightly silver a metal surface, such as brass or copper, so as to make any figures engraved thereon appear more distinct. Clock faces, dials and the scales of thermometers and barometers are cases in point, and if the surface be well lacquered with white lacquer after being silvered, such a coating is very durable. Silvering fluids or powders containing mercury should never be used unless the articles are to be afterwards exposed to a red heat so as to drive off the mercury. A silvering fluid which is very commonly sold to housekeepers under the name of *Novargent* or *Plate Renovator*, consists merely of nitrate of mercury or quicksilver. When rubbed on a copper cent or a brass stair-rod it gives it at once a bright silvery surface, but the brightness soon fades and the article, if brass, becomes black and dirty, while if it should be a piece of plated ware it will be ruined. Stair-rods and similar articles, if well silvered with powder No. 1, and then lacquered with good lacquer, will present a white silvery appearance for a long time. Plated goods should be re-coated by the electro-plating process.

Silvering Powder.—1. Nitrate of silver, 30 grains; common salt, 30 grains; cream tartar, 200 grains. Mix. Moisten with water and rub on the article with wash leather. Gives a white silvery appearance to brass, copper, etc.

2. *Novargent.*—Add common salt to a solution of nitrate of silver until the silver has all been precipitated. Wash the white precipitate or chloride of silver and add a strong solution of hyposulphite of soda until the white chloride is dissolved. Mix the resulting clear liquid with pipe-clay which has been finely powdered and thoroughly washed.

3. 1 oz. of nitrate of silver dissolved in 1 quart of rain or distilled water. When thoroughly dissolved, add a few crystals of hyposulphite of soda, which will at first form a brown precipitate, but which redissolves if sufficient hypo-

sulphite has been employed. The solution may be used by simply dipping a sponge in it, and rubbing it over the article to be coated. A solution of gold may be made and used in the same manner.

4. *Silvering Amalgam.*—A coating of silver, heavier than can be obtained by the above, may be given by the following process: Precipitate silver from its solution in nitric acid by means of copper. Take of this powder ½ oz.; common salt, 2 oz.; sal ammoniac, 2 oz.; and corrosive sublimate, 1 drachm. Make into a paste with water. Having carefully cleaned the copper surface that is to be plated, boil it in a solution of tartar and alum, rub it with the above paste, heat red hot and then polish.

Size.

The size used for filling the pores of plaster, wood, cloth, paper, etc., for the purpose of preparing it to receive paint or varnish, is usually made from glue. Where large quantities are used the size is obtained in barrels from the glue factory, and as the trouble and expense of concentrating it into cakes is thus avoided, it may be obtained at a very cheap rate. Size may be made by any one from clippings of skins, tendons, etc., boiled down to jelly and carefully freed from fat. Very fine size is prepared from parchment clippings. Where size is made from glue the following directions will prove useful:

Sizing for Window Shades.—Stretch the muslin well upon the frame. Soak over night one-half pound of the best white glue in 4 gallons water; in the morning turn it off and boil the glue. It must be very thin. Add a small piece of castile soap scraped fine. To have it more transparent add 2 oz. powdered alum. It must be put on quick, while warm. Gamboge for painting shades must be dissolved in alcohol; carmine in spirits of hartshorn.

Size for Improving Poor Drawing Paper.—Take 1 oz. of white glue, 1 oz. of white soap, and ½ oz. of alum. Soak the glue and the soap in water until they appear like jelly; then simmer in 1 quart of water until the whole is melted. Add the alum, simmer again and filter. To be applied hot.

Gold Size.—This is an entirely different article, and is in reality a very strong drying oil colored to resemble gold, and used for cementing gold leaf to articles that are to be gilt.

To prepare it, drying or boiled oil is thickened with yellow ochre or calcined red ochre, and carefully reduced to the utmost smoothness by grinding. It is thinned with oil of turpentine. It improves by age.

Skins—Tanning and Curing.

Curing Fur Skins.—The following are the directions given in the "Trapper's Guide," by Newhouse, an experienced trapper and hunter. 1. As soon as possible after the animal is dead, attend to the skinning and curing. The slightest taint of putrefaction loosens the fur and destroys the value of the skin. 2. Scrape off all superfluous flesh and fat, but be careful not to go so deep as to cut the fibre of the skin. 3. Never dry a skin by the fire or in the sun, but in a cool, shady place, sheltered from rain. If you use a barn door for a stretcher, nail the skin on the *inside* of the door. 4. Never use "preparations" of any kind in curing skins, nor even wash them in water, but simply stretch and dry them as they are taken from the animal. In drying skins it is important that they should be stretched tight like a drum-head.

To prepare Sheep Skins for Mats.—1. Make a strong soap lather with hot water and let it stand till cold; wash the fresh skin in it, carefully squeezing out all the dirt from the wool; wash it in cold water till all the soap is taken out. Dissolve a pound each of salt and alum in 2 gallons of hot water, and put the skin into a tub sufficient to cover it; let it soak for 12 hours and hang it over a pole to drain. When well drained, stretch it carefully on a board to dry, and stretch several times while drying. Before it is quite dry sprinkle on the flesh side 1 oz. each of finely pulverized alum and saltpetre, rubbing them in well. Try if the wool be firm on the skin; if not, let it remain a day or two, then rub again with alum; fold the flesh sides together and hang in the shade for two or three days, turning them over each day till quite dry. Scrape the flesh side with a blunt knife and rub it with pumice or rotten stone. Very beautiful mittens can be made of lambs' skins prepared in this way.

2. The following process has been found to succeed very well with sheep skins, dog skins and similar hides: Tack the skin upon a board with the flesh side out, and then scrape with a blunt knife; next rub it over hard with pulverized chalk, until it will absorb no more. Then take the skin off

from the board and cover it with pulverized alum, double half-way over, with the flesh side in contact; then roll tight together and keep dry for three days, after which unfold and stretch it again on a board or floor, and dry in the air, and it will be ready for use.

Skins of Rabbits, Cats and small Animals.—Lay the skin on a smooth board, the fur side undermost, and fasten it down with tinned tacks. Wash it over first with a solution of salt; then dissolve 2½ oz. of alum in 1 pint of warm water, and with a sponge dipped in this solution, moisten the surface all over; repeat this every now and then for three days. When the skin is quite dry take out the tacks, and rolling it loosely the long way, the hair side in, draw it quickly backwards and forwards through a large smooth ring until it is quite soft, and then roll it in the contrary way of the skin and repeat the operation. Skins prepared in this way are useful in many experiments, and they make good gloves and chest protectors.

Stains.

Stains of different kinds are removed either by dissolving the offensive matter out of the material which it has soiled or by destroying it. Ordinary washing is a good example of the first method; the removal of fruit stains by means of chloride of lime illustrates the second. Sometimes it is necessary to combine both methods. In practice it is of course necessary to avoid the use of any solvent or bleaching agent that can injure the material from which the stain is to be removed. The following is a list of the stains which most frequently occur, and also of the best methods of removing them:

Acids.—Most acids produce red stains in all black or blue colors of vegetable origin. Where the acid has not been so strong as to injure the texture of the fabric, such stains may be easily removed by the use of a little potash, soda or ammonia. Nitric acid, however, not only turns red, but bleaches the goods, and it is very difficult to remove stains caused by this acid. It is said that the yellow stains formed on brown or black woolen goods by nitric acid can be removed, when freshly formed, by moistening them repeatedly with a concentrated solution of permanganate of potash, and then rinsing with water. Yellow stains on the hands may be

treated in the same way, and the dark brown coloration produced may then be removed by treating with aqueous solution of sulphurous acid.

Aniline Dyes.—A solution of common sodium sulphite will rapidly remove the stains of most of the aniline dyes from the hands.

Fruit Stains.—Most fruits yield juices which, owing to the acid they contain, permanently injure the tone of the dye; but the greater part may be removed without leaving a stain, if the spot be rinsed in cold water in which a few drops of aqua ammoniæ have been placed, before the spot has dried. Wine stains on white materials may be removed by rinsing with cold water, applying locally a weak solution of chloride of lime, and again rinsing in an abundance of water. Some fruit stains yield only to soaping with the hand, followed by fumigation with sulphurous acid; but the latter process is inadmissible with certain colored stuffs. If delicate colors are injured by soapy or alkaline matters, the stains must be treated with colorless vinegar of moderate strength.

Grease.—1. Where the fabric will bear it, the best method of removing grease spots is simple washing with soap and water. No ordinary grease spot will resist this.

2. Chalk, fuller's-earth, steatite or "French chalk." These should be merely diffused through a little water to form a thin paste, which is spread upon the spot, allowed to dry, and then brushed out.

3. Ox-gall and yolk of egg, which have the property of dissolving fatty bodies without affecting prrceptibly the texture or colors of cloth. The oxgall should be purified, to prevent its greenish tint from degrading the brilliancy of dyed stuffs, or the purity of whites. Thus prepared it is the most effective of all substances known for removing this kind of stains, especially for woolen cloths. It is to be diffused through its own bulk of water, applied to the spots, rubbed well into them with the hands till they disappear, after which the stuff is to be washed with soft water.

4. The volatile oil of turpentine. This will take out only recent stains; for which purpose it ought to be previously purified by distillation over quicklime.

5. Benzine or essence of petroleum is commonly used for removing grease spots; but these liquids present the inconvenience of leaving, in most cases, a brownish *aureola.* To

avoid this, it is necessary, whilst the fabric is still saturated. and immediately the stain has disappeared, to sprinkle gypsum or lycopodium over the whole of the moistened surface. When dry, the powder is brushed away.

5. Balls for removing grease spots are made as follows: Take fuller's-earth, free from all gritty matter; mix with half a pound of the earth, so prepared, half a pound of soda, as much soap, and eight yolks of eggs well beaten up with half a pound of purified ox-gall. The whole must be triturated upon a porphyry slab; the soda with the soap in the same manner as colors are ground, mixing in gradually the eggs and the ox-gall previously beaten together. Incorporate next the soft earth by slow degrees, till a uniform thick paste be formed, which should be made into balls or cakes of a convenient size, and laid out to dry. A little of this detergent being scraped off with a knife, made into a paste with water, and applied to the stain, will remove it.

Ink and Iron Mould.—Fresh ink and the soluble salts of iron produce stains which, if allowed to dry, and especially if afterwards the material has been washed, are difficult to extract without injury to the ground. When fresh, such stains yield rapidly to a treatment with moistened cream of tartar, aided by a little friction, if the material or color is delicate. If the ground be white, oxalic acid, employed in the form of a concentrated aqueous solution, will effectually remove fresh iron stains.

A concentrated solution of pyrophosphate of soda removes many kinds of ink from delicate fabrics without altering the coloring matters printed upon the tissues, or in any way injuring them.

Mildew.—Make a very weak solution of chloride of lime in water (about a heaped-up teaspoonful to a quart of water); strain it carefully, and dip the spot on the garment into it; and if the mildew does not disappear immediately, lay it in the sun for a few minutes, or dip it again into the solution. The work is effectually and speedily done, and the chloride of lime neither rots the cloth nor removes delicate colors, when sufficiently diluted, and the articles well rinsed afterward in clear water.

Another method is to wet the spot in lemon juice, then spread over it soft soap and chalk mixed together, and spread where the hottest rays of the sun will beat upon it for half

an hour; if not entirely removed repeat the same. Or wet in clear lemon juice and lay in the sun; or soak for an hour or two, and then spread in the sun.

Nitrate of Silver.—Nitrate of silver, it will be remembered, is the base of most of the so-called indelible inks used for marking linen in almost every household. Stains or marks of any kind made with silver solution or the bath solution of photographers may be promptly removed from clothing by simply wetting the stain or mark with a solution of bichloride of mercury. The chemical result is the change of the black-looking nitrate of silver into chloride of silver, which is white or invisible on the cloth. Bichloride of mercury can be had at the drug stores. It is slightly soluble in water, is a rank poison, and we would not advise anybody to keep it about one's house.

The immediate and repeated application of a very weak solution of cyanide of potassium (accompanied by thorough rinsings in clean water), will generally remove these stains without injury to the colors.

Paint.—Stains of oil-paint may be removed with bisulphide of carbon; many by means of spirits of turpentine; if dry and old, with chloroform. For these last, as well as for tar-spots, the best way is to cover them with olive oil or butter. When the paint is softened, the whole may be removed by treatment, first, with spirits of turpentine, then with benzine.

Tar.—Tar and pitch produce stains easily removed by successive applications of spirits of turpentine, coal-tar naphtha, and benzine. If they are very old and hard, it is well to soften them by lightly rubbing with a pledget of wool dipped in good olive oil. The softened mass will then easily yield to the action of the other solvents. Resins, varnishes and sealing wax may be removed by warming and applying strong alcohol. Care must always be taken that, in rubbing the material to remove the stains, the friction shall be applied the way of the stuff, and not indifferently backwards and forwards.

Steel—Working and Tempering.

Most workmen find themselves, at times, compelled to forge and temper their own tools, such as drills, cold chisels, etc. The following hints will be of service:

Forging Steel.—Beware of over-heating the piece to be

forged, and also be careful that the fire is free from sulphur. Small drills are easily heated in the flame of a lamp or candle ; a Bunsen burner will heat sufficiently quite a good sized tool. Charcoal makes the best fire for all kinds of tools. If you are compelled to use common bituminous coal let the fire burn until most of the sulphur has been driven off. Do not hammer with heavy blows after the steel has cooled. By tapping it lightly, however, until it becomes black, the closeness of the grain is increased.

To Restore burnt Cast Steel.—Heat it to a bright cherry red and quench it in water. Do this a few times and then forge it carefully, and it will be nearly as good as before. The various recipes for mixtures for restoring burnt steel are worthless.

Hardening and Tempering Steel.—Heat the steel to a bright cherry red and plunge it in water that has been thoroughly boiled and then allowed to cool. It will then be "as hard as fire and water will make it," and too hard for anything except hardened bearings, or tools for cutting and drilling glass and very hard metals.

Where very hard tools are required, as, for example, for cutting steel or glass, mercury is the best liquid for hardening steel tools. The best steel, when forged into shape and hardened in mercury, will cut almost anything. We have seen articles made from ordinary steel, which have been hardened and tempered to a deep straw color, turned with comparative ease with cutting tools, from good tool steel hardened in mercury.

To make it stand work without breaking, it must be *tempered.* To do this, polish the surface on a grindstone or with emery paper, so that any change in the color of the metal may be easily seen. Then heat the tool until the cutting edge shows the proper color, as given below. Large drills and cold chisels are hardened and tempered at one operation, the cutting edge being cooled and hardened while the upper part is left hot. When taken from the water the heat from the shank passes towards the cutting edge and brings it to the right degree of softness. Small drills may be best tempered in the flame of a lamp. A spirit lamp is best, and the neatest plan is to heat the drill a short distance from the point and allow the heat to flow towards the cutting edge. As soon as the right color is seen on the edge, the

entire tool is plunged in water and cooled. In this way the shank is kept soft and the tool is not so apt to snap off.

The following are the degrees of heat (Fahrenheit) and corresponding colors to which tools for different purposes should be brought:

Temperature.	*Color.*	*Temper.*
430° 450°	Very faint yellow. Pale straw color.	Very hard; suitable for hammer faces, drills for stone, etc.
470° 490°	Full yellow. Brown.	Hard and inelastic; suitable for shears, scissors, turning tools for hard metal, etc.
510° 538°	Brown with purple spots. Purple.	Suitable for tools for cutting wood and soft metals, such as plane irons, knives, etc.
550° 560°	Dark blue. Full blue.	For tools requiring strong cutting edges without extreme hardness; as cold chisels, axes, cutlery, etc.
600°	Grayish blue verging on black.	Spring temper; saws, swords.

To Temper Steel on one Edge.—Red hot lead is an excellent thing in which to heat a long plate of steel that requires softening or tempering on one edge. The steel need only to be heated at the part required, and there is little danger of the metal warping or springing. By giving sufficient time, thick portions may be heated equally with thin parts. The ends of wire springs that are to be bent or riveted may be softened for that purpose by this process, after the springs have been hardened or tempered.

Blazing Off.—Saws and springs are generally hardened in various compositions of oil, suet, wax and other ingredients, which, however, lose their hardening property after a few weeks constant use; the saws are heated in long furnaces, and then immersed horizontally and edgewise in a long trough containing the composition; two troughs are commonly used, the one until it gets too warm, then the other for a period, and so on alternately. Part of the composition is wiped off the saws with a piece of leather, when they are removed from the trough, and they are heated, one by one, over a

clear coke fire, until the grease inflames; this is called "blazing off."

The composition used by an experienced saw maker is two pounds of suet and a quarter of a pound of beeswax to every gallon of whale oil; these are boiled together, and will serve for thin works and most kinds of steel. The addition of black resin, to the extent of about one pound to the gallon, makes it serve for thicker pieces, and for those it refused to harden before; but the resin should be added with judgment, or the works will become too hard and brittle. The composition is useless when it has been constantly employed for about a month; the period depends, however, on the extent to which it is used, and the trough should be thoroughly cleansed out before new mixture is placed in it.

The following recipe is recommended: Twenty gallons of spermaceti oil; twenty pounds of beef suet, rendered; one gallon of neatsfoot oil; one pound of pitch; three pounds of black resin.

These last two articles must be previously melted together, and then added to the other ingredients; when the whole must be heated in a proper iron vessel, with a close cover fitted to it, until the moisture is entirely evaporated, and the composition will take fire on a flaming body being presented to its surface, but which must be instantly extinguished again by putting on the cover of the vessel.

When the saws are wanted to be rather hard, but little of the grease is burned off; when milder, a larger portion; and for a spring temper, the whole is allowed to burn away.

When the work is thick, or irregularly thick and thin, as in some springs, a second and third dose is burned off, to insure equality of temper at all parts alike.

Gun-lock springs are sometimes literally fried in oil for a considerable time over a fire in an iron tray; the thick parts are then sure to be sufficiently reduced, and the thin parts do not become the more softened from the continuance of the blazing heat. But for ordinary steel articles which are required to be soft, tough and springy, the usual plan is to harden and then dip them in any coarse oil, and heat them over the fire until the oil blazes.

Springs and saws appear to lose their elasticity, after hardening and tempering, from the reduction and friction they undergo in grinding and polishing. Toward the conclu-

sion of the manufacture, the elasticity of the saw is restored, principally by hammering, and partly by heating it over a clear coke fire to a straw color ; the tint is removed by very diluted muriatic acid, after which the saws are well washed in plain water and dried.

Welding Steel.—As we have already stated in the article on *Iron*, welding is in reality a species of autogenous soldering. And, as in soldering or brazing, it is necessary to keep the surfaces that are to be united, free from dirt and oxide, so in welding, the surfaces must be perfectly clean or the joint will be imperfect. In welding common iron, sand is the flux generally used. When it is required to weld steel to iron, the steel must be heated to a less degree than the iron, as it is the most fusible. The surfaces should be thoroughly cleaned before they are brought together. Sal ammoniac cleans the dirt from the steel, and borax causes the oxide to fuse before it attains that heat which will burn the steel ; consequently, a mixture of these two substances forms one of the best materials for welding.

The best mode of preparing this mixture is as follows : Take ten parts of borax and one part of sal ammoniac and grind them together. Then melt them together, and when cold reduce the mixture to fine powder, and preserve in a well-stopped jar or bottle.

To Blue Steel.—The mode employed in bluing steel is merely to subject it to heat. The dark blue is produced at a temperature of 600°, the full blue at 500°, and the blue at 550°. The steel must be finely polished on its surface, and then exposed to a uniform degree of heat. Accordingly, there are three ways of coloring ; first, by a flame producing no soot, as spirits of wine ; secondly, by a hot plate of iron ; and thirdly, by wood ashes. As a very regular degree of heat is necessary, wood ashes for fine work are to be preferred. The work must be covered over with them, and carefully watched ; when the color is sufficiently heightened, the work is perfect.

To Blue Small Steel Articles.—Make a box of sheet iron ; fill it with sand and subject it to a steady heat. The articles to be blued must be finished and well polished. Immerse the articles in the sand, keeping watch of them until they are of the right color, when they should be taken out and immersed in oil.

Sulphur.

Sulphur or brimstone is a well-known yellow substance largely used in the manufacture of matches, gunpowder and sulphuric acid. Aside from these uses, which are of interest only to large manufacturers, sulphur is employed for bleaching, disinfecting, making moulds for plaster casts, and as a cement for fastening iron bars in stone sockets.

Sulphur, when burned, produces sulphurous acid, a gas which destroys most vegetable colors and the germs of most diseases. As a bleaching agent it is sometimes to be preferred to chlorine, as it does not injure the fabrics so much. The method of using it is to hang the articles to be bleached in a large box or closet in which the sulphur is afterwards burned. The easiest way to burn the sulphur is to dip heavy brown paper in melted sulphur, and burn the matches thus produced. In this way the sulphur is exposed to the air sufficiently to cause it to continue to burn when once ignited. Another very good plan is to place the sulphur on a block of iron or brick which has been previously heated to above the melting point of sulphur. The sulphur, if then ignited, will continue to burn freely, but it is almost impossible to get a cold mass of sulphur to burn freely.

The same method answers for disinfecting rooms, and sulphurous acid vapors are the least injurious and most easily procured of all our disinfectants. The National Board of Health, in their recent "Instructions for Disinfection," say that "fumigation with sulphur is the only practicable method for disinfecting the house. For this purpose the rooms to be disinfected must be vacated. Heavy clothing, blankets, bedding, etc., should be opened and exposed during the fumigation. Close the rooms as tightly as possible, ignite the sulphur, and allow the room to remain closed for twenty-four hours. For a room about ten feet square at least two pounds of sulphur should be used; for larger rooms, proportionally increased quantities." Of course in making arrangements for burning the sulphur great care must be exercised so as not to set the floor on fire. Safety is best secured by placing the burning sulphur over a tub of water or a considerable heap of sand or soil.

In making moulds for taking plaster casts, the sulphur must be rendered plastic. This is an extraordinary property possessed by this material, and one known only to chemists

and experts. When sulphur is melted and poured into water, instead of becoming hard it remains quite soft like dough, and in this state it may be pressed into the most minute crevices of a medal or other object, so as to take a perfect mould of it. From this mould plaster casts or electrotypes may be taken. After a short time the sulphur returns to its original hard, yellow, brittle condition.

As a cement for fastening iron rods in the holes sunk in stones, as in the gratings of windows and the iron work of fences, sulphur is now extensively used instead of lead. To pure sulphur, however, there is this very strong objection that it is exceedingly brittle and is readily fractured, and even reduced to coarse powder by sudden changes of temperature. We have seen a huge roll of sulphur broken simply by the heat of the hand. This may be avoided, in a measure, by mixing the melted sulphur with some inert powder like sand. Iron filings have also been mixed with it for the purpose.

Tin.

Tin is a brilliant, silvery-white metal. It is very malleable, but its power to resist tensile strains is so small that it is not very ductile. When bent it emits a peculiar crackling sound, arising from the destruction of cohesion amongst its particles. When a bar of tin is rapidly bent backwards and forwards several times successively, it becomes so hot that it cannot be held in the hand.

Tin is acted upon by caustic alkalies (potash and soda), but resists the acids of fruit, etc.; hence its use for coating iron so as to prevent corrosion and rust. Tin plate is sheet iron which has been coated with tin. To apply the tin the iron must be heated, and this is apt, in some cases, to injure the articles to be tinned, as it softens the iron, or in other words draws its temper. The process described under the head "Iron," page 70, enables us to avoid this difficulty.

Tin forms alloys with various metals, those of lead and copper being best known. That with lead is known as solder and pewter (see under these heads); that with copper is bronze, gun metal or "composition."

Tin and iron may be fused together in all proportions, forming apparently homogeneous alloys. Berthier describes one containing 35·1 per cent. of tin, and another containing 50 per cent. of tin, both being very brittle and capable of

being reduced to an impalpable powder. The affinity of iron for tin is also well illustrated in common tin plate, which is nothing more than sheet iron superficially combined with tin, to which a further quantity adheres without being in combination. The alloy of tin and iron upon the plate, however, is so thin that it can easily be removed by mechanical friction; and the amount of tin thus alloyed is probably not much larger than one-half of one per cent. Tin, when added to pig iron, imparts to it a steel-like texture of fine grain and great hardness without very great brittleness. Such iron is easily fused, and gives a sound like a bell. Indeed, in the Great International Exhibition of 1851, there was a large bell of cast iron stated to be alloyed with a small proportion of tin. According to Karsten, pig iron with one per cent. of tin yields a somewhat cold-short wrought iron with about 0·19 per cent. of tin. Such iron, it is stated, works well under the hammer, but at a white heat white vapors escape. With more tin, the iron in welding gave much waste and produced cold-short iron, with a fine, white and dull grain. For specific purposes, however, especially where great hardness is required, iron with a small amount of tin, not exceeding 0·3 per cent. seems to be well adapted. Sterling, in England, hardens the tops of rails with tin, and according to a report of the English Commission for testing iron in regard to its adaptability for railroad purposes, the best Dundyvan bar iron, if alloyed with 0·22 per cent. of tin, supported, without breaking, a weight of 23·39 tons to the square inch. Ott fused wrought iron with 0·5 per cent. of tin, and arrived at results similar to those of Karsten. Whilst at a welding heat it worked very well, the smith stating that it was some of the toughest iron he had ever worked. The grain was found to be fine and steel-like, with strong lustre and bright color.

Varnish.

It is in general more economical to buy varnishes than to make them on the small scale. Occasionally, however, our readers may find themselves in a situation where a simple recipe for a good varnish will prove valuable. We give a few recipes which are easily followed, and which will undoubtedly prove useful in special cases.

Basket Ware, Varnish for.—The following varnish for

basket work is said to dry rapidly, to possess sufficient elasticity, and to be applicable with or without admixture of color: Heat 375 grains of good linseed oil on a sand bath until it becomes stringy, and a drop placed on a cold, inclined surface does not run; then add gradually 7,500 grains of copal oil varnish, or any other copal varnish. As considerable effervescence takes place, a large vessel is necessary. The desired consistency is given to it, when cold, by addition of oil of turpentine.

Black Varnish for Optical Work.—The external surfaces of brass and iron are generally blacked or bronzed with compositions given under the head of *lacquers.* The insides of the tubes of telescopes and microscopes should be coated with a dead black varnish so as to absorb the light and prevent any glare. The varnish that is generally used for this purpose consists of lampblack, made liquid by means of a very thin solution of shellac in alcohol, but such varnish, even when laid on warm metal, is very apt to scale off and thus produce two serious evils—the exposure of the bright metallic surface and the deposit of specks on the lenses. It will therefore be found that lampblack, carefully ground in turpentine, to which about a fifth of its volume of gold size or boiled linseed oil has been added, will adhere much more firmly. The metal should be warm when the varnish is applied. Care must be taken not to use too much gold size, otherwise the effect will be a bright black instead of a dead black.

Black Varnish for Cast Iron.—1. For those objects to which it is applicable one of the best black varnishes is obtained by applying boiled linseed oil to the iron, the latter being heated to a temperature that will just char or blacken the oil. The oil seems to enter into the pores of the iron, and after such an application the metal resists rust and corrosive agents very perfectly.

2. Fuse 40 oz. of asphaltum and add ½ a gallon of boiled linseed oil, 6 oz. red lead, 6 oz. litharge, and 4 oz. sulphate of zinc, dried and powdered. Boil for two hours and mix in 8 oz. fused dark amber gum and a pint of hot linseed oil, and boil again for two hours more. When the mass has thickened withdraw the heat and thin down with a gallon of turpentine.

Green Varnish.—There is a most beautiful transparent

green varnish employed to give a fine glittering color to gilt or other decorated works. As the preparation of this varnish is very little known, an account of it may in all probability prove of interest to many of our readers. The process is as follows : Grind a small quantity of a peculiar pigment called "Chinese blue," along with about double the quantity of finely-powdered chromate of potash, and a sufficient quantity of copal varnish thinned with turpentine. The mixture requires the most elaborate grinding or incorporating of its ingredients, otherwise it will not be transparent, and therefore useless for the purpose for which it is intended. The "tone" of the color may be varied by an alteration in the proportion of the ingredients. A preponderance of chromate of potash causes a yellowish shade in the green, as might have been expected, and *vice versa* with the blue under the same circumstances. This colored varnish will produce a very striking effect in japanned goods, paper hangings, etc., and can be made at a very cheap rate.

Iron Work, Bright Varnish for.—Dissolve 3 lbs. of resin in 10 pints boiled linseed oil, and add 2 lbs. of turpentine.

Map Varnish.—Clear Canada balsam, 4 oz.; turpentine, 8 oz. Warm gently and shake until dissolved. Maps, drawings, etc., which are to be varnished with this solution, should be first brushed over with a solution of isinglass and allowed to dry thoroughly.

Mastic.—Mastic, 6 oz.; turpentine, 1 quart. Tough, hard, brilliant and colorless. Excellent for common woodwork.

Metals—Bright, Varnish for.—In order to make alcoholic varnish adhere more firmly to polished metallic surfaces, A. Morell adds one part of pure crystallized boracic acid to 200 parts of the varnish. Thus prepared it adheres so firmly to the metal that it cannot be scratched off with the finger nail ; it appears, in fact, like a glaze. If more boracic acid is added than above recommended the varnish loses its intensity of color.

Paintings, Varnish for.—A good varnish can be made as follows : Mastic, six ounces ; pure turpentine, one-half ounce ; camphor, two drachms ; spirits of turpentine, nineteen ounces ; add first the camphor to the turpentine. The mixture is made in a water-bath, and when the solution is effected, add the mastic and the spirits of turpentine near the end of the operation, then filter through a cotton cloth. The varnish should be laid on very carefully.

Rust, Varnish for Preventing.—A varnish for this purpose may be made of 120 parts resin, 180 sandarac, 50 gumlac. They should be heated gradually until melted, and thoroughly mixed, then 120 parts turpentine added, and subsequently, after further heating, 180 parts rectified alcohol. After careful filtration, it should be put into tightly-corked bottles.

Shellac Varnish.—Dissolve good shellac or seed lac in alcohol, making the varnish of any consistence desired. Note.—Shellac gives a pale cinnamon colored varnish. Varnish made with seed lac is deeper colored and redder. If colorless varnish is desired use bleached shellac, an article which is to be had at most drug stores.

Tortoise Shell Japan.—Take good linseed oil, one gallon ; amber, one-half pound ; boil together until the fluid is brown and thick. Then strain through a cloth and boil again until of consistency of pitch, when it is fit for use. Having prepared this varnish well, clean the article to be japanned, and then brush the parts over with vermillion mixed with shellac varnish, or with drying oil diluted with turpentine. When this coat is dry, brush the whole with the amber varnish diluted to a proper consistency with turpentine, and then, when set firm, put the article into a hot stove to undergo heat for as long a time as required to produce the desired effect. In some instances as much as two weeks may be required, after which finish in an annealing oven.

Turpentine Varnish.—Clear pale resin, 5 lbs.; turpentine, 7 lbs. Dissolve in any convenient vessel.

Varnish for Violins and similar articles.—Sandarach, 6 oz.; mastic, 3 oz.; turpentine varnish, one-half pint ; alcohol 1 gallon. Keep in a tight tin can in a warm place until the gums are dissolved.

Varnish for Replacing Turpentine and Linseed Oil Paints.—Fr. Theis, of Bissendorf, prepares a varnish consisting of 100 parts of resin, 20 parts of crystallized carbonate of soda, and 50 parts of water, by heating these substances together and mixing them with a solution of 24 parts of strong liquor ammonia in 250 parts of water. With the mass thus obtained the pigments are levigated without the addition of linseed oil or turpentine ; the paint dries readily without the aid of a drier and looks very well, especially when varnished. The paint keeps well, even under water, and becomes very hard.

The cost is said to be about one-third that of ordinary oil paints.

White, Hard Varnish for Wood or Metal.—Mastic, 2 oz.; sandarach, 8 oz.; elemi, 1 oz.; Strasbourg or Scio turpentine, 4 oz.; alcohol, 1 quart.

White Varnish for Paper, Wood or Linen.—Sandarach, 8 oz.; mastic, 2 oz.; Canada balsam, 4 oz.; alcohol, 1 quart.

White Spirit Varnish.—Rectified spirit, 1 gallon; gum sandarach, 2½ lbs. Put these ingredients into a tin bottle, warm gently and shake till dissolved. Then add a pint of pale turpentine varnish.

Wood, Parisian Varnish for.—To prepare a good varnish for fancy woods, dissolve one part of good shellac in three to four parts of alcohol of 92 per cent. in a water-bath, and cautiously add distilled water until a curdy mass separates out, which is collected and pressed between linen; the liquid is filtered through paper, all the alcohol removed by distillation from the water bath, and the resin removed and dried at 100° centigrade until it ceases to lose weight; it is then dissolved in double its weight of alcohol of at least 96 per cent., and the solution perfumed with lavender oil.

Wood—Stained, Varnish for.—A solution of four ounces of sandarac, one ounce gum mastic, and four ounces shellac, in one pound of alcohol, to which two ounces oil of turpentine is added, can be recommended as a varnish over stained woods.

Varnishing.

Before beginning to varnish, it is necessary that the surface to which it is to be applied, should be perfectly free from all grease and smoke stains, for it will be found if this is not attended to, the varnish will not dry hard. If the varnish is to be applied to old articles, it is necessary to wash them very carefully with soap and water before applying it. When it is wished that the varnish should dry quickly and hard, it is necessary to be careful that the varnish should always be kept as long a time as possible before being used; and also that too high a temperature has not been used in manufacturing the varnish employed. It is likewise customary, when it can be done, to expose the article to the atmosphere of a heated room. This is called stoving it, and is found to greatly improve the appearance of the

work, as well as to cause the varnish to dry quickly. After the surface is varnished, to remove all the marks left by the brush, it is usually carefully polished with finely-powdered pumice stone and water. Afterwards, to give the surface the greatest polish it is capable of receiving, it is rubbed over with a clean soft rag, on the surface of which a mixture of very finely powdered tripoli and oil has been applied. The surface is afterwards cleaned with a soft rag and powdered starch, and the last polish is given with the palm of the hand. This method is, however, only employed when those varnishes are used which, when dry, become sufficiently hard to admit of it.

A good surface may be produced on unpainted wood by the following treatment: Glass-paper the wood thoroughly as for French polishing, size it, and lay on a coat of varnish, very thin, with a piece of sponge or wadding covered with a piece of linen rag. When dry, rub down with pumice dust, and apply a second coat of varnish. Three or four coats should produce a surface almost equal to French polish, if the varnish is good and the pumice dust be well applied between each coat. The use of a sponge or wadding instead of a brush aids in preventing the streaky appearance usually caused by a brush in the hands of an unskilled person.

When varnish is laid on a piece of cold furniture or a cold carriage-body, even after it has been spread evenly and with dispatch, it will sometimes "crawl" and roll this way and that way as if it were a liquid possessing vitality and the power of locomotion. It is sometimes utterly impossible to varnish an article at all satisfactorily during cold weather and in a cold apartment. In cold and damp weather a carriage, chair or any other article to be varnished should be kept in a clean and warm apartment where there is no dust flying, until the entire woodwork and iron-work have been warmed through and through, to a temperature equal to that of summer heat—say eighty degrees. That temperature should be maintained day and night. If a fire is kept for only eight or ten hours during the day, the furniture will be cold, even in a warm paint-room. Before any varnish is applied, some parts of the surface which may have been handled frequently, should be rubbed with a woolen cloth dipped in spirits of turpentine, so as to remove any greasy, oleaginous matter which may have accumulated. Table-beds, backs of chairs, and fronts

of bureau drawers are sometimes so thoroughly glazed over that varnish will not adhere to the surface, any more than water will lie smoothly on recently painted casings. The varnish should also be warm—not hot—and it should be spread quickly and evenly. As soon as it flows from the brush readily and spreads evenly, and before it commences to set, let the rubbing or brushing cease. One can always do a better job by laying on a coat of medium heaviness, rather than a very light coat or a covering so heavy that the varnish will hang down in ridges. Varnish must be of the proper consistency, in order to flow just right and to set with a smooth surface. If it is either too thick or too thin one cannot do a neat job.

When it is wished to varnish drawings, engravings, or other paper articles, it is usual to give them a coat of size before applying the varnish. For the preparation of *Size* see article under that head.

To Restore Spotted Varnish.—If the varnish has been blistered by heat or corroded by strong acids, the only remedy is to scrape or sandpaper the article and revarnish. Spots may often be removed by the following process : Make a mixture of equal parts of linseed oil, alcohol and turpentine, *slightly* moisten a rag with it, and rub the spots until they disappear. Then polish the spot with ordinary blotting paper. Varnish injured by heat can hardly be restored in any other way than by removing it and applying a fresh coat.

Voltaic Batteries.

In every kind of battery it is essential that the connections be bright, and that the metal surfaces which are to be united should be brought together under considerable pressure. Those batteries which depend for contact upon light springs, and the mere placing of wires in holes, lose a great deal of available power. The surfaces ought invariably to be filed bright and pressed together by means of screws. We have frequently seen the action of the batteries used for medical purposes entirely stopped by a thin film of oxide.

The zincs also should always be thoroughly amalgamated to prevent waste. When the zincs are new and uncorroded, amalgamation is an easy process. Dip the zincs in dilute sulphuric acid (8 parts water and 1 of acid), and rub them

with mercury. The mercury will adhere quite readily and render the entire surface brilliant and silvery. But when the zincs are old and corroded it will be found that the mercury does not adhere to some parts. In such cases wash the surface of the zinc with a solution of nitrate of mercury and it will become coated with amalgam. Once the surface is touched, it is easy to add as much mercury as may be desired by simply rubbing on the liquid metal.

The coating of mercury adds greatly to the durability of the zincs, as when so prepared the acid will not act on them except when the current is passing, and from the excellent condition of the entire surface the power of the battery is greatly increased.

Watch—Care of.

1. Wind your watch as nearly as possible at same hour every day. 2. Be careful that the key is in good condition, as there is much danger of injuring the works when the key is worn or cracked; there are more main springs and chains broken through a jerk in winding than from any other cause, which injury will sooner or later be the result if the key be in bad order. 3. As all metals contract by cold and expand by heat, it must be manifest that to keep the watch as nearly as possible at one temperature, is a necessary piece of attention. 4. Keep the watch as constantly as possible in one position, that is, if it hangs by day let it hang by night, against something soft. 5. The hands of a pocket chronometer or duplex watch should never be set backwards; in other watches this a matter of no consequence. 6. The glass should never be opened in watches which set and regulate at the back. One or two directions more it is of vital importance that you bear in mind. On regulating a watch, should it be fast, move the regulator a trifle towards the slow; and if going slow, do the reverse; you cannot move the regulator too slightly or too gently at a time, and the only inconvenience that can arise is having to perform the operation more than once. On the contrary, if you move the regulator too much at a time, you will be as far, if not further than ever, from attaining your object, so that you may repeat the movement until quite tired and disappointed, stoutly blaming both watch and watchmaker, while the fault is entirely your own. Again, you cannot be too careful in respect of the

nature and condition of your watch-pocket; see that it be made of something soft and pliant, such as wash-leather, which is the best, and also that there be no flue or nap that may be torn off when taking the watch out of the pocket. Cleanliness, too, is as needful here as in the key before winding; for, if there be dust or dirt in either instance, it will, you may rely upon it, work its way into the watch, as well as wear away the engine-turning of the case.

Waterproofing.

Porous goods are made waterproof according to two very distinct systems. According to the first the articles are made absolutely impervious to water and air by having their pores filled up with some oily or gummy substance, which becomes stiff and impenetrable. Caoutchouc, paints, oils, melted wax, etc., are of this kind. The other system consists in making the fabric *repellent* to water, while it remains quite porous and freely admits the passage of air. Goods so prepared will resist any ordinary rain, and we have seen a very porous fabric stretched over the mouth of a vessel and resist the passage of water one or two inches deep. The following recipes have been tried and found good. Most of those found in the recipe books are worthless.

To Render Leather Waterproof.—1. Melt together 2 oz. of Burgundy pitch, 2 oz. of soft wax, 2 oz. of turpentine, and 1 pint of raw linseed oil. Lay on with a brush while warm.

2. Melt 3 oz. lard and add 1 oz. powdered resin. This mixture remains soft at ordinary temperatures, and is an excellent application for leather.

Water-proof Canvas for Covering Carts, etc.—9½ gallons linseed oil, 1 lb. litharge, 1 lb. umber, boiled together for 24 hours. May be colored with any paint. Lay on with a brush.

To Make Sailcloth Impervious to Water, and yet Pliant and Durable.—Grind 6 lbs. English ochre with boiled oil, and add 1 lb. of black paint, which mixture forms an indifferent black. An ounce of yellow soap, dissolved by heat in half a pint of water, is mixed while hot with the paint. This composition is laid upon dry canvas as stiff as can conveniently be done with the brush. Two days after, a second coat of ochre and black paint (without any soap) is laid on, and, allowing this coat time to dry, the canvas is finished with a

coat of any desired color. After three days it does not stick together when folded up. This is the formula used in the British navy yards, and it has given excellent results. We have seen a portable boat made of canvas prepared in this way and stretched on a skeleton frame.

Metallic Soap for Canvas.—The following is highly recommended as a cheap and simple process for coating canvas for wagon tops, tents, awnings, etc. It renders it impermeable to moisture, without making it stiff and liable to break. Soft soap is to be dissolved in hot water, and a solution of sulphate of iron added. The sulphuric acid combines with the potash of the soap, and the oxide of iron is precipitated with the fatty acid as insoluble iron soap. This is washed and dried, and mixed with linseed oil. The soap prevents the oil from getting hard and cracking, and at the same time water has no effect on it.

The following recipes are intended to be applied to woven fabrics, which they leave quite pervious to air but capable of resisting water.

1. Apply a strong solution of soap, not mere soap suds, to the wrong side of the cloth, and when dry wash the other side with a solution of alum.

2. The following recipe is substantially the same as the preceding, but if carefully followed in its details gives better results :

Take the material successively through baths of sulphate of alumina, of soap and of water ; then dry and smother or calender. For the alumina bath, use the ordinary neutral sulphate of alumina of commerce (concentrated alum cake), dissolving 1 part in 10 of water, which is easily done without the application of heat. The soap is best prepared in this manner : Boil 1 part of light resin, 1 part of soda crystals, and 10 of water, till the resin is dissolved ; salt the soap out by the addition of one-third part of common salt ; dissolve this soap with an equal amount of good palm oil soap (navy soap) in 30 parts of water. The soap bath should be kept hot while the goods are passing through it. It is best to have three vats along side of each other, and by a special arrangement to keep the goods down in the baths. Special care should be taken to have the fabric thoroughly soaked in the alumina bath.

3. Drs. Hager and Jacobsen remark that during the last

few years very good and cheap waterproof goods of this description have been manufactured in Berlin, which they believe is effected by steeping them first in a bath of sulphate of alumina and of copper, and then into one of water-glass and resin soap.

Whitewash.

The process of whitewashing is known by various names, such as "calcimining." "kalsomining," etc., most of them derived evidently from the latin name for *lime*, which was the principal ingredient of all the older forms of whitewash.

Professors of the "Art of Kalsomining" affect a great deal of mystery, but the process is very simple. It consists simply in making a whitewash with some neutral substance which is made to adhere by means of size or glue. It contains no caustic material like lime. Several substances have been used with good results. The best is zinc white. It gives the most brilliant effect but is the most expensive The next is Paris white or sulphate of baryta. This, when pure, is nearly equal to zinc white, but, unfortunately, common whiting is often sold for it, and more often mixed with it. It is not difficult, however, to detect common whiting either when alone or mixed with Paris white. When vinegar, or better still, spirits of salt, is poured on whiting, it foams or effervesces, but produces no effect on Paris white. Good whiting, however, gives very fair results and makes a far better finish than common lime as ordinarily used. When well made, however, good lime whitewash is very valuable for out-houses, and places where it is desirable to introduce a certain degree of disinfecting action. One of the best recipes for lime whitewash is that known as the "White House" whitewash, and sometimes called "Treasury Department" whitewash, from the fact that it is the recipe sent out by the Lighthouse Board of the Treasury Department. It has been found, by experience, to answer on wood, brick and stone, nearly as well as oil paint, and is much cheaper. Slake one-half bushel unslaked lime with boiling water, keeping it covered during the process. Strain it and add a peck of salt, dissolved in warm water ; three pounds ground rice, put in boiling water and boiled to a thin paste ; one-half pound powdered Spanish whiting and a pound of clear glue, dissolved in warm water ;

mix these well together and let the mixture stand for several days. Keep the wash thus prepared in a kettle or portable furnace, and, when used, put it on as hot as possible with painters' or whitewash brushes.

Kalsomine, as distinguished from lime whitewash, is best suited for the interior of rooms in the dwelling house. To kalsomine a good sized room with two coats, proceed as follows :

Select some very clear colorless glue and soak ¼ lb. in water for 12 hours. Then boil it, taking great care that it does not burn, and this is best done by setting the vessel with the glue in a pan of water over the fire. When completely dissolved add it to a large pail of hot water, and into any desired quantity of this stir as much of the white material used as will make a cream. The quality of the resulting work will depend on the skill of the operator, but we may remark that it is easier to get a smooth hard finish by using three coats of thin wash than by using one coat of thick. If you have time for but one coat, however, you must give it body enough, In giving more than one coat let the last coat contain less glue than the preceding ones.

Kalsomine, such as we have described, may be colored by means of any of the cheap coloring stuffs.

The following is recommended as a good kalsomining fluid for walls : White glue, 1 pound ; white zinc, 10 pounds ; Paris white, 5 pounds ; water, sufficient. Soak the glue over night in three quarts of water, then add as much water again, and heat on a water bath till the glue is dissolved. In another pail put the two powders, and pour on hot water, stirring all the time, until the liquid appears like thick milk. Mingle the two liquids together, stir thoroughly, and apply to the wall with a whitewash brush.

It is often desirable to "kill" old whitewash, as it is called. as otherwise it would be impossible to get new whitewash or paper to stick to the walls. After scraping and washing off all lose material give the walls a thorough washing with a solution of sulphate of zinc (2 oz. to 1 gallon of water). The lime will be changed to plaster of Paris, and the zinc will be converted into zinc white, and if a coat of kalsomine be now given it will adhere very strongly and have great body.

Wood—Floors.

The following method of staining floors in oak or walnut colors is highly commended by the London *Furniture Gazette*: Put 1 oz. Vandyke brown in oil, 3 oz. pearlash, and 2 drms. dragon's blood, into an earthenware pan or large pitcher; pour on the mixture 1 quart of boiling water; stir with a piece of wood. The stain may be used hot or cold. The boards should be smoothed with a plane and glass-papered; fill up the cracks with plaster of Paris; the brush should not be rubbed across the boards, but lengthwise. Only a small piece should be done at a time. By rubbing on one place more than another an appearance of oak or walnut is more apparent; when quite dry, the boards should be sized with glue size, made by boiling glue in water, and brushing it in the boards hot. When this is dry, the boards should be papered smooth and varnished with brown hard varnish or oak varnish; the brown hard varnish will wear better and dry quicker; it should be thinned with a little French polish, and laid on the boards with a smooth brush.

Wax for Polishing Floors.—To prepare this, 12½ pounds yellow wax, rasped, are stirred into a hot solution of 6 pounds good pearlash, in rain water. Keeping the mixture well stirred while boiling, it is first quiet, but soon commences to froth; and when the effervescence ceases, heat is stopped, and there are added to the mixture, while still stirring, 6 pounds dry yellow ochre. It may then be poured into tin cans or boxes, and hardens on cooling. When wanted for use, a pound of it is diffused into 5 pints boiling hot water, and the mixture well stirred, applied while still hot to the floor by means of a paint brush. It dries in a few hours, after which the floor is to be polished with a large floor brush and afterwards wiped with a coarse woolen cloth A coat of this wax will last six months.

Wood—Polishing.

Knotted or cross-grained wood cannot be planed with the planes used for deal, but with a special tool, of which the iron is placed at a more obtuse angle. These planes can be had in wood or metal, and are in general use by cabinet-makers. They are named according to the angle at which the iron is placed. For deal and soft wood this is 45 degrees, or York pitch; while the iron set at 55 degrees, middle pitch, or 60

degrees, half pitch, is used for molding planes for soft and hard wood. When the latter is, however, very knotty, it is worked over in all directions with a toothing plane, so as to cut across the fibres and reduce the surface to a general level. It is then finished by the scraper, often a piece of freshly broken glass, but more properly a thin plate of steel set in a piece of wood, and ground off quite square. The edge is then often rubbed with a burnisher, to turn up a slight wire edge. This will scrape down the surface of the wood until it is ready for "papering," *i. e.*, being further smoothed by glass or sandpaper. This is to be rubbed in all directions, until the work has an even surface, and the lines thus produced are further reduced by the finest sandpaper, marked 00. After this it is rubbed over with a bit of flannel, dipped in linseed oil, and allowed to dry. This oiling is then repeated, and the work again set aside for a day or more, until the oil is fairly absorbed.

If the wood be porous it must first be *filled*, as it is called, and for this nothing is better than whiting colored so as to resemble the wood and kept dry. Rub the wood with linseed oil and then sprinkle it with whiting. Rub the latter well in, wipe it off carefully and give time to dry. This is far superior to size.

The polish—French polish—is made by dissolving shellac in alcohol, methylated spirits, or even naphtha. This is facilitated by placing the jar or bottle in a warm place, on a stove or by the fire. Other gums are often added, but are not generally necessary. In short, no two polishers use precisely similar ingredients, but shellac is the base of all of them. The following recipes have been collected from various sources more or less reliable:

1. Shellac, 4 oz.; alcohol, 1 pint.....2. Shellac, 4 oz.; sandarac, ½ oz.; alcohol, 1 pint.....3. Finishing polish: Alcohol (95 per cent.), ½ pint; shellac, 2 dr.; gum benzoin, 2 dr.; put into a bottle, loosely corking it, and stand it near a fire, shaking it occasionally. When cold, add two teaspoonfuls of poppy oil, and shake well together.

These, it must be remembered, are polishes to be applied by means of rubbers, and not by a brush. Those used in the latter way are varnishes, such as are applied to cheap wares and also to parts of furniture and such articles as are carved and cannot in consequence be finished by rubbing.

The polisher generally consists of a wad of list rolled spirally, tied with twine and covered with a few thicknesses of linen rag. Apply a little varnish to the middle of the rubber and then enclose the latter in a soft linen rag folded twice. Moisten the face of the linen with a little raw linseed oil applied to the middle of it by means of the finger. Pass the rubber quickly and lightly over the surface of the work in small circular strokes until the varnish becomes nearly dry; charge the rubber with varnish again and repeat the rubbing till three coats are laid on, when a little oil may be applied to the rubber and two more coats given it. Proceed in this way until the varnish has acquired some thickness; then wet the inside of the linen cloth, before applying the varnish, with alcohol, and rub quickly, lightly and uniformly, the whole surface. Lastly, wet the linen cloth with a little oil and alcohol, without varnish, and rub as before till dry. Each coat is to be rubbed until the rag appears dry, and too much varnish must not be put on the rag at one time. Be also very particular to have the rags clean, as the polish depends in a great degree upon keeping everything free from dust and dirt.

To insure success the work must be done in a warm room, free from dust.

Turned articles must be brought to a fine smooth surface with the finest sandpaper, and the direction of the motion should be occasionally reversed so that the fibres which are laid down by rubbing one way may be raised up and cut off. To apply the polish, which is merely a solution of shellac in alcohol, take three or four thicknesses of linen rag and place a few drops of polish in the centre; lay over this a single thickness of linen rag and and a drop or two of raw linseed oil over the polish. The rubber is then applied with light friction over the entire surface of the work while revolving in the lathe, never allowing the hand or mandrel to remain still for an instant, so as to spread the varnish as evenly as possible, especially at the commencement, and paying particular attention to the internal angles, so as to prevent either deficiency or excess of varnish at those parts. The oil, in some degree, retards the evaporation of the spirit from the varnish and allows time for the process; it also presents a smooth surface and lessens the friction against the tender gum. When the varnish appears dry, a second,

third and even further quantities are applied in the same manner, working, of course, more particularly upon those parts at all slighted in the earlier steps.

Wood—Staining.

In preparing any of the tinctures used for staining, it is of importance to powder or mash all the dry stuffs previous to dissolving or macerating them, and to purify all the liquids by filtration before use. Their coloring powers, which mainly depend on very accurate combinations of the requisite ingredients, should always be carefully tested before a free use is made of them, and the absorbent properties of the materials intended to be stained should be tested likewise. It will be better for inexperienced hands to coat twice or three times with a weak stain than only once with a very strong one, as by adopting the first mode a particular tint may be gradually effected, whereas, by pursuing the latter course, an irremediable discoloration may be the result. Coarse pieces of carving, spongy end, and cross-grained woods, should be previously prepared for the reception of stain ; this is best done by putting on a thin layer of varnish, letting it dry, and then glass-papering it completely off again. Fine work merely requires to be oiled and slightly rubbed with the finest glass-paper. Thus prepared, the woody fibre is enabled to take on the stain more regularly, and to retain a high degree of smoothness. When stain is put on with a flat hog-hair tool, it is usually softened by a skilful but moderate application of a badger-hair softener. The steel comb is chiefly employed for streaking artificial oak, and the mottler is used for variegating and uniting the shades and tints of mahogany. Flannels and sponges are often used instead of brushes, but the implements most serviceable for veining or engraining purposes are small badger sash tools and sable pencils. The effect produced by a coat of stain cannot be ascertained until it has been allowed sufficient drying period.

This process may be used either for improving the natural color of wood or for changing it so completely as to give it the appearance of an entirely different kind of timber. Thus a light mahogany may be greatly improved by being made darker, and there are many other kinds of timber that are

greatly improved by a slight change in their color. The following notes will be of use in the latter direction :

A solution of asphaltum in spirits of turpentine, makes a good brown stain for coarse oaken work, which is only intended to be varnished with boiled oil.

When discolored ebony has been sponged once or twice with a strong decoction of gall-nuts, to which a quantity of iron filings or rust has been added, its natural blackness becomes more intense.

The naturally pale ground and obscure grain of Honduras mahogany is often well brought out by its being coated first with spirits of hartshorn, and then with oil, which has been tinged with madder or venetian red.

Grayish maple may be whitened by carefully coating it with a solution of oxalic acid to which a few drops of nitric acid have been added.

Half a gallon of water in which ½ lb. of oak bark and the same quantity of walnut shells or peels have been thoroughly boiled, makes an excellent improver of inferior rosewood ; it is also far before any other of its kind for bringing out walnut.

Raw oil, mixed with a little spirits of turpentine, is universally allowed to be the most efficacious improver of the greater number of materials. Beautiful artificial graining may be imparted to various specimens of timber by means of a camel-hair pencil, with raw oil alone, that is, certain portions may be coated two or three times very tastefully, so as to resemble the rich varying veins which constitute the fibril figures ; while the common, plain parts, which constitute the ground shades, may only be once coated with the oil, very much diluted with spirits of turpentine. The following are a few useful stains :

Mahogany.—1. Water, 1 gallon ; madder, 8 oz. ; fustic, 4 oz. Boil. Lay on with a brush while hot, and while wet streak it with black to vary the grain. This imitates Honduras mahogany.

2. Madder, 8 oz. ; fustic, 1 oz. ; logwood, 2 oz. ; water, 1 gallon. Boil and lay on while hot. Resembles Spanish mahogany.

3. A set of pine shelves, which were brushed two or three times with a strong boiling decoction of logwood chips, and varnished with solution of shellac in alcohol, appear almost

like mahogany both in color and hardness. After washing with decoction of logwood and *drying thoroughly*, they received two coats of varnish. They were then carefully sandpapered and polished, and received a final coat of shellac varnish.

Imitation Ebony.—There are two processes in use for giving to very fine grained wood the appearance of ebony. One is a mere varnish, and may be applied in a few minutes, as it dries very rapidly. Either French polish, made black with any fine coloring matter, or good "air-drying black varnish," may be applied. This, however, gives only a superficial coloring, and when the edges and corners of the work wear off, the light-colored wood shows. The other method is as follows: Wash any compact wood with a boiling decoction of logwood three or four times, allowing it to dry between each application. Then wash it with a solution of acetate of iron, which is made by dissolving iron filings in vinegar. This stain is very black and penetrates to a considerable depth into the wood, so that ordinary scratching or chipping does not show the original color. Some recipes direct the solutions of logwood and iron to be mixed before being applied, but this is a great mistake.

Black Walnut Stain.—1. Take asphaltum, pulverize it, place it in a jar or bottle, pour over it about twice its bulk of turpentine, put it in a warm place, and shake it from time to time. When dissolved, strain it and apply it to the wood with a cloth or stiff brush. If it should make too dark a stain thin it with turpentine. This will dry in a few hours. If it is desired to bring out the grain still more, apply a mixture of boiled oil and turpentine; this is better than oil alone. Put no oil with the asphaltum mixture or it will dry very slowly. When the oil is dry the wood can be polished with the following: Shellac varnish, of the usual consistency, 2 parts; boiled oil, 1 part. Shake it well before using. Apply it to the wood by putting a few drops on a cloth and rubbing briskly on the wood for a few moments. This polish works well on old varnished furniture.

2. The appearance of walnut may be given to white woods by painting or sponging them with a concentrated warm solution of permanganate of potassa. The effect is different on different kinds of timber, some becoming stained very rapidly, others requiring more time for the result. The per-

manganate is decomposed by the woody fibre ; brown peroxide of manganese is precipitated, and the potash is afterwards removed by washing with water. The wood, when dry, may be varnished.

Brown Stain.—Paint over the wood with a solution made by boiling 1 part of catechu (cutch or gambier) with 30 parts of water and a little soda. This must be allowed to dry in the air, and then the wood is to be painted over with another solution made of 1 part of bichromate of potash and 30 parts of water. By a little difference in the mode of treatment and by varying the strength of the solutions, various shades of color may be given with these materials, which will be permanent and tend to preserve the wood.

Staining Oak.—According to Neidling, a beautiful orange-yellow tone, much admired in a chest at the Vienna Exhibition, may be imparted to oak wood by rubbing it in a warm room with a certain mixture until it acquires a dull polish, and then coating it after an hour with thin polish, and repeating the coating of polish to improve the depth and brilliancy of the tone. The ingredients for the rubbing mixture are about three ounces of tallow, three-fourths of an ounce of wax, add one pint of oil of turpentine, mixed by heating together and stirring.

Darkening Oak Framing.—Take one ounce of carbonate of soda, and dissolve in half pint boiling water ; take a sponge or piece of clean rag, saturate it in the solution and pass gently over the wood to be darkened, so that it is wet evenly all over ; let it dry for 24 hours. Try first on an odd piece of wood to see color ; if too dark, make the solution weaker by adding more water ; if not dark enough, give another coat. This may always be kept ready for use in a bottle corked up.

Imitation Rosewood.—Boil one-half pound of logwood in three pints of water till it is of a very dark red ; add one-half ounce of salt of tartar. Stain the work with the liquor while it is boiling hot, giving three coats ; then, with a painter's graining brush, form streaks with the following liquor : Boil one-half-pound of logwood chips in two quarts of water ; add one ounce of pearlash, and apply hot.

Zinc.

Zinc, when cast into plates or ingots, is a brittle metal, easily broken by blows from a hammer. In this state it is evidently somewhat porous, as its specific gravity is only 6·8, while that of rolled zinc rises as high as 7·2. Zinc, when heated to 212° Fah., or over, becomes malleable and ductile, and when rolled into sheets it becomes exceedingly tough and does not regain its brittle character on cooling. Hence, sheet zinc has come into very extensive use in the arts.

To Pulverise Zinc.—Zinc becomes exceedingly brittle when heated to nearly its melting point. To reduce it to powder, therefore, the best plan is to pour melted zinc into a dry and warm cast-iron mortar, and as soon as it shows signs of solidifying pound it with the pestle. In this way it may be reduced to a very fine powder.

Black Varnish for Zinc.—Professor Böttger prepares a black coating for zinc by dissolving two parts nitrate of copper and three parts crystallized chloride of copper in sixty-four parts of water, and adding eight parts of nitric acid. This, however, is quite expensive ; and in some places the copper salts are very difficult to obtain. On this account Puscher prepares black paint or varnish with the following simple ingredients : Equal parts of chlorate of potash and blue vitriol are dissolved in thirty-six times as much warm water, and the solution left to cool. If the sulphate of copper used contains iron, it is precipitated as a hydrated oxide, and can be removed by decantation or filtration. The zinc castings are then immersed for a few seconds in the solution until quite black, rinsed off with water, and dried. Even before it is dry, the black coating adheres to the object so that it may be wiped dry with a cloth. A more economical method, since a much smaller quantity of the salt solution is required, is to apply it repeatedly with a sponge. If copper-colored spots appear during the operation, the solution is applied to them a second time, and after a while they turn black. As soon as the object becomes equally black all over, it is washed with water and dried. On rubbing, the coating acquires a glittering appearance like indigo, which disappears on applying a few drops of linseed-oil varnish or "wax milk," and the zinc has then a deep black color and gloss.

APPENDIX

Adamantine, or Boron Diamond.—This term has been applied to a crystalline form of boron prepared by heating boracic acid—or, what is still better, amorphous borun—with aluminium in a crucible. The name is not a very happy one, as it has been applied to several other articles, and the term "boron" would be much better. Crystallized boron, or adamantine, has not yet come into use in the arts; but from the fact that it is not very difficult to prepare, its peculiar properties may lead to some useful applications.

Wagner gives the following details in regard to its preparation; and as they are not very complicated or delicate, it forms a fine field for amateur experiment: 100 parts of anhydrous boracic acid are mixed with 60 parts of sodium in a small iron crucible heated to a red heat. To this mixture 40 or 50 parts of common salt are added, and the crucible luted down. As soon as the reaction is finished, the mass—consisting of amorphous boron with boracic acid, borax, and common salt intermingled—is stirred into water acidified with hydrochloric acid. The boron is filtered out, washed with a weak solution of hydrochloric acid, and placed upon a porous stone to dry, at the ordinary temperature. From this amorphous boron the crystalline boron, or adamantine, is prepared, as follows:—A small crucible is filled with amorphous boron, in the center of which a small bar of aluminium, weighing 4 to 6 grammes, is placed. The crucible is submitted to a temperature sufficient to melt nickel for 1½ to 2 hours. After cooling, the aluminium will be found covered with beautiful crystals of boron. The diamond boron is easily separated from the

graphitoid. The crystals vary in color from a scarcely perceptible honey-yellow to deep garnet red: sometimes they are so deeply colored, probably by amorphous boron, that they appear black. In luster and refracting power they are nearly equal to the diamond. Their specific gravity is 2·63. They are extremely hard,— always sufficiently so to scratch corundum, or even the ruby, with facility; and some crystals are nearly as hard as the diamond itself. The hardest are obtained by repeatedly exposing aluminium to the action of boric anhydride at a temperature high enough to cause the anhydride to volatilize very quickly.

From the character of boron it would seem eminently fitted for many purposes in the arts. For cutting-tools for very hard substances, for jewels for timepieces, etc., and for ornamental jewelry, it seems specially valuable. Its luster, hardness, and wide range of color, would seem to give it peculiar value for artificial gems.

Aquarium.— The aquarium is now not only an interesting plaything and a handsome house ornament, but an important means of studying the habits of those plants and animals that live in water, and of watching the effect of the different species upon each other and upon the purity of the element in which they live. It therefore deserves the careful attention of those who are interested in these subjects, and consequently demands more than a passing notice at our hands.

The term *aquarium* was formerly applied to any tank or small pond used for growing aquatic plants; and in this sense it is used by Loudon. But since the principles which regulate the balance of organic nature have been studied in connection with this subject, the name has been restricted to those tanks or vessels in which a self-supporting system of plants and animals has been placed. The principles which control the successful management of an aquarium are very beautiful, and not difficult to understand.

Animals which live constantly under water breathe just as truly as do those animals that live on land, the difference in

the methods of breathing of the two kinds being that while land animals take in the air directly into their breathing apparatus, the water animals depend for their supply of oxygen upon the air that is dissolved in the water that they inhabit. The proportion of air which is held in solution by water is considerable, being greater in cold weather and under increased pressure. It is a curious fact that the oxygen dissolves in water more freely than does nitrogen; consequently the air which is supplied to fishes through the medium of water is always richer in oxygen than is the air that is breathed by land animals. But under any circumstances the oxygen contained in a few gallons of water is soon exhausted by a comparatively small number of fish, and its place is occupied by carbonic acid,—a gas which is entirely unfit for supporting life. The carbonic acid, into which the breathing of animals converts oxygen, may be removed, and its place supplied by the life-sustaining gas in two ways: (1) by mechanically agitating the water and exposing it freely to the air, and (2) by the action of plants. The first method has been frequently employed in aquaria in public museums,—a pair of bellows or some such device being employed to force air in at the bottom of the tank, and in this way agitate it and "aerate" it. This, however, is a crude and unscientific makeshift. The action of plants is far more efficient and more interesting. Every plant, when its leaves are exposed to light, absorbs the gas that is exhaled by animals (carbonic acid), decomposes it, appropriates the carbon to itself, and sets the oxygen free. The plant, in its action on the air, is thus directly antagonistic to the animal: it undoes what the animal does, and the two forms of life thus constitute a balance which maintains the air in its purity, and the waters of rivers, lakes, and oceans, in their life-giving qualities. This is the principle which is made use of in the management of a properly kept aquarium: plants are introduced in numbers and quantities sufficient to decompose the noxious gases given off by the animals, and the latter, in their turn, supply carbon to the plants.

If no death, no decay, and no obnoxious growths ever occurred in the tanks, they would keep healthy and clear for an indefinite time, provided they were once properly balanced in the way we have described. But since minute animals will die and remain unseen, and plants will drop their dead leaves, death in some form or another is present all the time, and this tends to disturb the pleasant condition of things. Therefore, in addition to ordinary plants and fish, it is necessary to introduce certain scavengers who will devour any dead vegetable or animal matter, and thus put a stop to its evil influence. Snails and tadpoles are the great scavengers of the aquarium, as indeed they are in nature, for a well-kept aquarium is merely a natural lake on a very small scale. The dissolved portion of dead plants and animals, as well as of their excreta, — whether the latter be solid fæcal matter or the excretions which are undoubtedly given off by the external surfaces of all animals, fish as well as others — are taken up by the roots of the plants and rapidly removed from the water; and so nicely may all these interdependent actions be adjusted that an aquarium has been covered with a tightly closed glass plate and the plants and animals kept in good health for months.

A careful study of these general laws will enable any one to manage an aquarium successfully; and there are few more beautiful objects in a room than a well-kept aquarium, with the water clear and the plants and animals in good health. But without a knowledge of these principles and a careful attention to them, the owner of an aquarium will be constantly groping in the dark and committing all sorts of blunders and mistakes.

Aquaria are of two classes,— fresh water and marine,— according as the water is salt or fresh. Dwellers on the seashore, who have facilities for procuring stock and water, find the marine aquaria by far the most beautiful and interesting; and even far inland this form is a favorite with experts, as the water, plants, and animals are easily sent by rail; or, if de-

sirable, an artificial sea-water may be used, which will answer every purpose.

When sea-water can not be procured for the marine aquarium, a substitute for it may be made as follows: Mix with 970,000 grains of rain-water 27,000 grains of chloride of sodium, 3,000 of chloride of magnesium, 750 of chloride of potassium, 29 of bromide of magnesium, 2,300 of sulphate of magnesia, 1400 of sulphate of lime, 35 of carbonate of lime, and 5 of iodide of sodium. These, all being finely powdered and mixed first, are to be stirred into the water, through which a stream of air may be caused to pass from the bottom until the whole is dissolved. On no account is the water to be boiled, or even to be heated. Into this water, when clear, the rocks and sea-weed may be introduced. As soon as the latter are in a flourishing state the animals may follow. Care must be taken not to have too many of these, and to remove immediately any dead ones. The loss that takes place from evaporation is to be made up by adding clear rain-water.

In such aquaria the beautiful anemones and other inhabitants of the ocean may be kept in perfect health for years. We would, however, advise our readers to commence with the fresh-water aquarium, as being the most easily procured, the most readily stocked, and as requiring the simplest management; and the following directions are intended to apply chiefly to that form.

Tanks.— Aquarium tanks are of all sizes and shapes, from the small fish-globe to the plate-glass tank, whose dimensions are measured by yards and whose contents are hundreds of gallons. In such tanks veritable whales have been kept in good health. On the other hand we have formed a microscopic aquarium out of a homeopathic phial, and in it have kept minute plants and animals for months in good condition.

Probably the most pleasant and useful size for an aquarium is about thirty inches for the length and fifteen each for width and depth. Such a tank is easily manageable, while at the same time it admits of a fine display of plants and rockwork,

and allows abundant room for the fish as well as nice resting-places for the amphibious animals. For ourselves, we confess that we have a liking for large tanks,—larger, even, than that just described. In such tanks we are able to watch the natural growth and development of most ordinary fish; the plants that are introduced need not be mere dwarfs; and the large body of water which they contain is not subject to such sudden and violent changes of temperature, unless exposed to the direct rays of the sun,—a condition which should never be allowed. But when the main tank is of a large size, it will in general be found necessary to have a few small ones for the more minute specimens, which would otherwise be difficult to find in the large tank.

Avoid globes and all tanks with curved surfaces, as they give a distorted view of the animals, and when large are easily broken by any tap or increase of pressure from within. It is true that for scientific purposes bottles of all kinds, and even test-tubes, may be used; and on one occasion, where we required a large number of vessels, we made good use of a lot of two-quart fruit-jars. But these are makeshifts, and not very good ones at that. Even hexagonal and octagonal vessels, although they are peculiar and somewhat pretty, we dislike, because the field of view (if we may so express it) is very limited. The fish, in moving about quickly, get behind another plane, and then the distortion is horrible. Now, what we want to secure is a clear and unobstructed view of all parts of the tank, so that the movements of the fish and the relations of the plants may be clearly and constantly visible when we wish them to be so. Nothing meets this requirement so thoroughly as a four-sided tank made of good plate-glass.

It is probable that most fish and other animals would prefer opaque sides, as more closely imitating a natural pond; and acting on this idea, some makers have constructed their tanks with backs made of slate. The idea is a good one for some purposes, such as experiments in fish-breeding, but the plan is unsuited to the wants of the naturalist. If an opaque back

is thought to be advantageous, just hang a black cloth behind the glass: this can be removed when a view from that side is needed.

Most tanks are made with cast-iron frames, into which the glass is cemented; and when the work is well done, so that the metal is nowhere exposed to the action of the water, this plan answers very well. The bottom, as well as the sides, should be of glass, however,—a plate of common window-glass, cemented to the cast-iron bottom, answering every purpose. A very excellent aquarium may be made with slate for the bottom; and for the corners four cast-iron pillars, into which the glass is cemented. The slab of slate should be considerably larger than the space inclosed by the glass, so as to secure abundant strength; and as slate is as easily cut and planed as wood, the edge may be molded so as to have a very handsome finish. A slab of marble is sometimes used, but it is entirely unsuitable, unless when covered with glass, firmly cemented to it. The reason of this is that marble is soluble in water containing carbonic acid, and it forms a deposit on the sides of the tank, besides injuring the fish.

Cements.—A great deal has been said about the cement proper to use for uniting the parts of the aquarium. Some authors tell us that any cement containing either lime or lead will be sure to injure the fish; but this must evidently depend very much upon the condition in which these materials are present in the cement.

White lead and ordinary building lime would probably be bad; but we have had tanks cemented with mixtures containing litharge, and also others containing good hydraulic cement, and after long exposure to pure water and to water containing carbonic acid, neither the lead nor the lime seemed to be dissolved to an extent that could be detected by the most delicate chemical tests, and neither did the plants or animals seem to suffer from any injurious effects. We therefore feel satisfied that the cements described in the article *Cements* in the former part of this work will fulfill every requirement.

Rock-work.— Rock-work is not only ornamental, but useful, as it furnishes hiding-places for the animals—all of which love seclusion at certain times. In selecting rocks, see that all those containing lime and other soluble matters are avoided. To determine this, pound some of the rock up and mix it with clear rain-water in a tumbler. After standing a day or two, evaporate a little of the water in a watch-glass, or even on a piece of thin window-glass, and if it leaves a considerable deposit the rock is soluble and consequently bad.

By keeping a sharp lookout we may often find rocks of a very picturesque form, and having little holes or pockets in their sides. These holes may be enlarged and used for holding small plants, which will grow in them freely.

Avoid all artificial nonsense like earthenware castles, submarine hermits, glass swans, cast-iron frogs, and the like. No person of taste would allow any such childish make-believes to have a place in an aquarium. So, too, avoid the incongruity of placing sea-shells and coral, however pretty and handsome, in a fresh-water aquarium. A sea-shell in a marine aquarium may be not only appropriate, but useful, as many animals use these deserted shells for burrows; but in a fresh-water aquarium they are entirely out of place. And yet we have seen not only large sea-shells in a fresh-water tank, but of a whole herd of china (not *Chinese*) cattle placed as if grazing on the bottom!

Water.— In procuring water for the aquarium, always select that which is as pure as possible. *Absolutely* pure water can not be had, even in the laboratory of the chemist, nor would it be desirable if it could be obtained. Distilled water is entirely unfit for *starting* an aquarium. The water of pure wells, lakes, and streams, is the most suitable. Some natural waters are so highly impregnated with lime, iron, or sulphur, that they are quite unsuited to our purpose, though we have seen both animals and plants thriving in such waters. It will be found, however, on examination, that these plants and animals have become acclimated,— as it were, reconciled to

their conditions; and also that there are at work certain countervailing influences which we may find it difficult to imitate. Whenever we have attempted to use such water,—and we have frequently done so for experiment,—all plants and animals not born and brought up in it have suffered.

Water impregnated with iron or sulphur is, in general, quite local in its occurrence. A certain pond or stream will be strongly tainted, and streams only a few yards distant will be quite pure. But in many districts of country, *all* the water contains such a large percentage of lime that it is unfit for aquarium purposes. In such cases recourse should be had to rain-water, caught at a distance from houses and well filtered. With such water we have succeeded admirably.

After the aquarium has been filled and the plants have begun to grow nicely, it will be found that the water gradually diminishes on account of evaporation; and this is specially marked in those aquaria that are kept in warm rooms, where the air is dry. In such cases it will be found that it is the water alone that evaporates and is wasted; the salts and other impurities remain behind. If we now fill up the tank with water, such as we originally used, and which contains the same amount of saline matter that the water did, it is evident that we add to the original impurities; and by keeping up this practice, we will soon have more salts present than is endurable. This is particularly the case with marine aquaria: if we keep on adding sea-water to make up for the evaporation, it will soon attain a Dead-Sea degree of saltness. To avoid this we must simply imitate Nature, and make up for the loss by evaporation by adding rain-water,—which should, however, for aquarium purposes, always be well filtered. At proper intervals—three months or so—we should draw off a large proportion of the water in the tank, and fill up with newly collected water,—fresh or salt, as the case may require.

It will sometimes be found that certain plants and animals whose habitat is boggy and impure water will not thrive well in any other. In such cases, the only way to secure success

is to set up a separate tank, in which the natural conditions are imitated as closely as possible.

Floor and Soil.—By "floor" is meant the surface of the sand, gravel, or earth, at the bottom of the tank. In the common fish-globes, this is frequently merely the glass itself, though sometimes a handful of gravel is used to cover the bottom. But in a properly constructed aquarium, where a considerable variety of animals and plants are to be kept, great attention should be paid to the floor and to the soil beneath it. Some animals are very fond of burrowing, and some of the plants require soil in which to grow, and the needs of both should be provided for.

The great difficulty will be found in regard to the soil. If merely placed on the bottom of the tank and covered with sand or small gravel, the crayfish, etc., will probably dig down to it, disturb it, and muddy the water. They like no better fun, but it spoils the aquarium. We have found that the best plan is to cover the bottom with rich soil, and then pave it over closely with thin, flat stones. The roots of the plants will find no difficulty in getting down, but the crayfish can not follow. As it is not well to have the soil packed too closely by the weight of the sand, gravel, and stones above, we generally mix it with small stones, and upon these the pavement rests. The pavement of thin stones is then covered to the depth of one or two inches with fine gravel or coarse sand. For the marine aquarium, well-washed sea-sand is the best: for the fresh-water aquarium, the best material will be found in the bed of some clear and rapid stream. This, when freed from mud by washing, will be sure to answer well. Where this can not be had, use good building-sand or gravel, well washed. The amount of washing required is something enormous; and unless this operation is thoroughly performed, the tank will never prove satisfactory. The sand should be so clean that when a handful of it is poured into a tall jar it will sink to the bottom in less than one minute and leave the water perfectly clear.

The beautiful white gravel used for roofing makes a very pleasing floor; but as it is brought from the sea it requires not only washing, but thorough soaking for some time before it can be used in the fresh-water aquarium.

Avoid limy and ferruginous sand; that is to say, sand that is impregnated with lime or iron. Such sand may, in general, be known by its peculiar reddish color.

The soil at the bottom of the tank may be any rich garden mould. Some plants—such as hornwort, anacharis, etc.—grow freely while simply floating in the water: these need no soil. Others do better when securely anchored; but for them sand or gravel is sufficient. There are some, however, like valisneria, beccabunga, cress, etc., that do not thrive well unless rooted in soil. There are two ways of supplying their needs: One is to cover the entire bottom of the aquarium with soil, and plant the specimens in this, covering it over with sand or fine gravel, as previously described. Another way—and the one which we confess we like best—is to set out the plants in small pots, which are sunk to the very bottom of the tank and concealed by a heap of rock. The pots for this purpose should be shallow: common flower-pots cut down answer very well. This can almost always be done very readily by means of an old saw. A height of 2½ inches is quite sufficient. A cocoanut-shell makes a good pot for such purposes. It does not decay readily; it is easily cut with a saw; and the bottom may be drilled full of fine holes, which is a great advantage. But the neatest and best pot may be made out of a piece of soft sandstone, cut with a chisel to the proper shape, and hollowed out for the reception of the soil. We have often wondered that the dealers in aquarium stock do not manufacture pots specially for this purpose. They should be of a shape the reverse of the common flower-pots,—that is, widest at the base.

STOCKING THE AQUARIUM.

The great mistake made by most beginners in stocking an aquarium is in getting too much animal life in proportion to

the cubic capacity of the tank. It is not often that we see too many plants, but we often see too many fishes. Fish are so easily obtained, they look so pretty, and form such interesting pets, that few beginners can refrain from keeping all that they can crowd in. Since the aquarium should be a means of instruction as well as pleasure, we would advise our readers to restrict themselves to one of each kind, unless in such cases as the sticklebacks, where pairs are necessary to enable us to watch their nest-building, hatching, and caring for their young.

Having obtained a tank and fitted it up with rock-work, and a nice clean floor, the first thing to be done is to set out those plants that are to take root in the subsoil. Then fill the tank gently and slowly with water, so as not to disturb the sand or gravel. This may be done by pouring the water on a large bung or piece of wood, which is allowed to float and rise as the tank fills, and is removed when sufficient water has been introduced. Floating plants may now be introduced, and also a few mollusks and tadpoles, and the whole allowed to stand for a few days exposed to the light, until the water has been brought into proper condition to receive the fishes and crustaceans. The latter may then be introduced. In all this, seek to obtain as great variety as possible,— unless, indeed, you desire to study carefully some one species or genus of plants or animals, and then, of course, you will be guided by the special purpose you may have in view. The inhabitants of the aquarium may be rudely classed as follows: Plants, mollusks, insects, crustaceans, reptiles, and fishes. To each of these divisions we shall devote a few words, though from want of space we are unable to give anything like a description of the different species. To do this would require a large volume.

Plants.— The plants most suitable for the aquarium are those which grow with their leaves entirely submerged. Large plants like calla, arrowhead, etc., which grow with their leaves in the air, do not act upon the water so effectually as those

small plants whose leaves obtain all their carbon from the water itself. Indeed, the plants which are most effective in aerating the water of the aquarium are probably those minute confervæ which are so apt to cover the rock and glass with a green coating.

Among the plants which are most useful are the following: *Vallisneria spiralis*, whose slender tape-like leaves sometimes reach a length of six feet in some of our rivers. It readily accommodates itself to the aquarium, and is not only an excellent aerater, but it harbors hosts of animalcules on which the fish feed greedily. Water millfoil is another excellent plant for our purpose. It may be found in the spring growing in dense masses in deep water. The "seed," a rather peculiar form of bud, may often be found floating in the water in very early spring. This bud, which looks like a round green seed, about half an inch in diameter, will, if placed in the aquarium, soon begin to grow and send out a long stem densely clothed with narrow leaves. It forms no roots, but grows floating in the water, and forms a pleasant shade for the animals in the tank. The *anacharis alsinastrum*, sometimes called water-thyme, is another excellent plant for this purpose. It is the plant which has caused so much trouble in England by choking up the rivers and canals. *Nitella* is also a good plant, and is frequently cultivated for the purpose of showing the circulation or rather cyclosis of the sap under the microscope, though a good *young* leaf of vallisneria is perhaps as good as any for this purpose. The duckweeds, frogbits, and starworts, are also great favorites.

The fact is, however, that the young collector can hardly go wrong. Any of the smaller plants found growing naturally under the water of our ponds and streams answer well for the aquarium; and it is a good lesson in botany to gather them, watch their growth, and learn their names.

Mollusks.— These are not only an interesting but an almost indispensably useful portion of the inhabitants of every well regulated aquarium. They serve to keep down the confervæ,

to remove decaying vegetable matter; and when well supplied with these they multiply very rapidly, and their eggs and young form excellent food for the fishes. The variety that may be found is very large, and every stagnant pond swarms with them. We would advise our readers to select a few of all the kinds that can be found, work out their names by studying books on the subject, and carefully watch their habits. Some of them have a curious habit of swimming on their backs on the surface of the water. They adhere to the smooth surface of the glass by "suction," creep along it with a curious motion, and literally "mow" off the confervæ with their tongues. All this can be easily seen through the glass by means of a good lens. The eggs, also, are most interesting objects. They are frequently deposited on the glass, and can then be studied very readily by means of a microscope. After a short time the young snail can be seen distinctly in the egg, and its motions easily observed. For tanks of fair size the fresh-water mussel is an interesting and beautiful inhabitant. Its pearl-white mantle and gorgeously colored shell are features which even the most unenthusiastic must admire.

Insects.—The larvæ of insects—and in a few cases the mature animals themselves—are interesting. The bottoms of most of our small ponds are alive with different species, some of which are very curious in their habits. It unfortunately happens, however, that the fish have a strong liking for them; and those for which the fish have not a strong liking have a strong liking for the fish, so that when we exclude both those that are easily destroyed and those that are destructive, the scope for choice is rather narrow. The water boatman (*Notonecta glaucus*) is a common inhabitant of ponds and puddles, and an interesting subject for the aquarium, and so is the whirligig (*Gyrinus natator*). The larvæ of the dragonfly and of the dytiscus are curious but destructive; and one of the most singular objects is the larvæ of the *Corydalus*. It is known also as the "helgramite," and is largely used for bait by fishermen. The motion of its external gills, when watched

under the microscope, is very curious. The large water-beetle (*Hydrous piceus*) is said by some to be harmless, but our experience does not bear this out.

But of all the insect inhabitants of the pond or tank, the caddis-worm is the most curious and wonderful. This curious insect builds a little house for itself, and carries it about on its back,—enlarging its dwelling as its body increases in bulk. These dwellings, or "cases" as they are called, are formed of sticks, stones, and other material, and are designed to afford protection to the animal while in its defenseless state. But it often happens that some trout or other voracious enemy comes along and swallows not only the poor cad, but his "castle" as well. As a still further protection, therefore, the caddis-worm endeavors to escape observation by forming his house as nearly as possible of the same color as his surroundings.

Crustaceans.—Crayfish and shrimp should by all means have a place in the aquarium. They are to be found in most streams by turning over the stones, and they are easily caught. Of the fresh-water crayfish we have one species in this country which seems to be spread over a pretty wide range, and is well known to anglers as a killing bait for bass and some other fish. Its scientific name is *Astacus Bartonii.* It breeds freely, and the young are curious little creatures. The old females may frequently be found with a number of their young adhering to their bodies under the tail; and when such a specimen can be captured it is well worth while to give her a separate tank, and try to rear the young.

In addition to the crayfish, the *grammarus* is well worthy of a place; and so is the *brachipus.* The *grammarus*, or fresh-water shrimp, is a favorite food of the trout, which always grows to a larger size, and has a superior flavor where they abound.

Insects, crustaceans, and reptiles are all apt to make efforts to escape during the night; and therefore the aquarium containing them should be carefully covered every evening, so as

to prevent this. The best cover is a light wooden frame, over which fine wire gauze is stretched.

Reptiles.— No aquarium can be considered complete without a frog or a tadpole. Watching a tadpole develop into a frog is a favorite amusement with young naturalists. First of all they gradually increase in size, and when this process has been carried to a certain extent the hind legs develop, and we have a curious compound—half fish, half reptile. After a time the fore legs make their appearance, the tail drops off, and the animal changes entirely its habits and necessities. It no longer lives in the water, for it is now an air-breathing creature; and whereas it formerly subsisted on vegetables and dead animal matter, it now feeds chiefly upon living insects, which it captures with wonderful dexterity. It is a singular fact, however, that these changes are greatly influenced by the condition in which the tadpole is placed. If confined in a dark place the change never comes at all, and it remains a tadpole all its life.

Besides the frog there are several other reptiles which are worthy of a place in the tank. The most interesting of these are the newts. There are several species, all quite pretty, and adding much to the variety of the stock. Some persons, it is true, can not endure the sight of these creatures; and where such idiosyncracies exist, the newts must be omitted. It must be borne in mind that where frogs and newts are kept some provision must be made for allowing them to spend a large portion of their time out of the water, otherwise they will certainly be drowned.

Fish.— In procuring fish for the aquarium, one of the greatest sources of pleasure will be the catching of them. The catching of small fish, under ordinary circumstances, is an insipid and to some a very distasteful occupation; but when it is done for purposes of study, or with a view to the stocking of an aquarium, a new element of pleasure is infused into the pursuit. Our streams and ponds abound with little fish that are easily caught, and make very interesting little pets. The

simplest and best way to capture them is with a small net made of "mosquito netting." The net is simply a bag stretched on a hoop about 18 inches in diameter, which in turn is fastened to a handle six or eight feet long. The bag should be at least twice as deep as long; and if the netting is new and white, it should be stained a dirty mud-color by means of logwood or coffee, as the glare of the white net would scare the fish. The fish may be driven into such a net, or it may be used like a landing-net. No great dexterity is required, and it is a matter of considerable interest to examine the "haul" and sort out the different species. The angler should in this case be satisfied with two or three of a kind, and all the others should be returned to the water. Remember that many of these fish are the young of larger ones, and when full grown afford good sport to the angler. And even if they are not the young of the larger kinds, they form the natural prey of the food-fishes, and should be carefully protected from wanton destruction.

The varieties that may be obtained are quite numerous. There are the minnows, the dace, the darters, and others. Very small perch and sunfish form very handsome pets in the aquarium, but they must be quite small or they will prove mischievous. Pickerel and bass can only be admitted while very young, and in association with fish much larger than themselves. They should be liberally supplied with *very* small fish; or if allowed to become hungry they will torment and even kill fish ten times their size.

Gold and silver fish and the different varieties of carps all form interesting additions to the stock. These may be procured from the dealers for a very small sum. A very small eel is a curious and amusing little creature, and should by all means be allowed a place, although Edwards denies them admission on the ground that they kill the mollusks.

But of all the fish that are procurable under ordinary circumstances the stickleback is the most interesting; and the following account of its habits and mode of caring for its

young can hardly fail to tempt those whose tastes lead them in this direction to repeat these observations. Mr. West gives the following account of his experience with a pair of sticklebacks:—

"In the spring of 1860 I procured some male and female sticklebacks, a single pair of which I placed in a fresh-water aquarium by themselves; and the remainder I deposited in a large salt-water tank, which was already pretty well stocked. The males of these quietly took possession of spots eligible for their nests and commenced building. They were, however, so much disturbed, and their work was so often destroyed by the crabs and other inmates of the aquarium that my experiment of breeding in my salt-water tank was for the season a failure. Not so in the fresh-water one. The male promptly selected a home for his expected family, taking all the labor upon himself. Here, again, poetry has been substituted for fact. Instead of 'gently alluring his mate to their new-made home,' and being 'a model husband,' truth compels me to say that he was the veriest of tyrants, and fiercely attacked his *cara sposa* if she dared to approach the nest during its construction. When his labor was completed, however, he as harshly attempted to drive her into it. During the progress of the building her meekness, submission, and affection were beyond all praise. She generally lay quietly in a corner of the aquarium, and when he chanced to come near her would immediately rise up perpendicularly, quivering her fins, rubbing herself against his side, and making every possible demonstration of tenderness. All the material for the nest was conveyed by the male in his mouth. It consisted of various confervæ, stems of nitella, etc., which were placed in layers, with a mouthful of sand or fine gravel occasionally dropped upon them to keep each layer in its place; and he frequently slowly rubbed himself over the whole mass, apparently covering it with a cement exuded from his body. When completed it was a compact nest, with a round passage through it of from one fourth to three eighths of an inch in diameter. Having given

it the finishing touch, he sought the female to drive her in. As I was at this moment watching the operation I had the rare opportunity of observing the actual depositing of the spawn, etc., of which no description has yet met my eye. The madam now acted with proverbial female coquetry and waywardness, and led her imperious spouse a chase a dozen or twenty times around the aquarium, avoiding the nest as obstinately as she had before eagerly sought it. At length she relented, and entered it at the orifice nearest the front of the aquarium. Her caudal fin alone remained visible, and I noticed that it had an incessant quivering motion. The depositing of the spawn lasted about forty seconds, and it was while the male excitedly hovered near that he almost literally 'turned as white as a sheet.' As she glided out at the further orifice he entered and performed his functions, also passing through the nest. Afterwards he closed the orifice and commenced an assiduity of attention to the nest that was most surprising. Night and day he kept guard over it for some eighteen days,—now strengthening its walls by additional stems of nitella, now thrusting his nose into the orifice to ascertain that the seal had not been violated; and every few minutes hovering over it, with his body inclined at an angle of forty-five degrees, fanning it with his pectoral fins, aided by a lateral motion of his tail. At length the young appeared, and the vigilance of *M. gasterosteus* was redoubled. On the day that I first saw the young ones, which I am pretty sure was the first day of their appearance, the delighted *pater familias* would not permit any of them to leave the mouth of the nest, the orifice to which he had torn open for them. On the second day their 'area of freedom' was slightly extended; but if they went beyond the limits he would take them in his mouth, as a cat does her kittens, and put them back into the nest. After a few days, however, he no longer restrained them of their liberty. Left to themselves, they soon spread themselves over the tank. I estimated their number at more than two hundred. From the time his parental duties ceased began the decadence of

the male's brilliant coloring. As for the female, seemingly conscious that her functions were entirely at an end, she lay at a remote part of the tank, concealed by a root of vallisneria, never venturing near her husband and children. In fact, when the young fry began to extend their travels, and were seemingly able to take care of themselves, I removed both the parents for fear of *accidents*, to wit, possible infanticide,—a precaution I recommend in all similar cases. With such positive evidence that the *male* stickleback *alone* 'attends to the little ones,' I could only smile when Mr. Hancock, a naturalist of some eminence, asserted, in an interesting and otherwise very correct description of this process of nidification which appeared in *The Zoölogist*, that 'it required all the *mother's* unremitting exertions, for several days after the fry were hatched, to keep them within bounds, so as to preserve them from danger.' Even Dr. Lankester falls into a similar error, publishing with his endorsement a communication from a correspondent who describes 'the *mother* fish' as 'continuing her attendance at the nest as long as any of the young fry were left.' As the correspondent was a woman, the mistake was a natural one."

Feeding the fish.—Fish in a well-arranged tank require very little food beyond that which is naturally produced in the water in which they live. Certain minute crustaceans (cyclops, water-fleas, etc.) breed with marvelous rapidity; and as they feed upon the almost invisible animalculæ, which in turn convert decaying vegetables into *their* food, a certain round or cycle of organic life is thus kept up. The eggs of snails also furnish a favorite food; and if a few "wigglers" can be procured and thrown into the tank the fish will rarely allow them to develop into mosquitoes. The plants also will furnish a certain amount of food, and a worm or two occasionally may be given to them by way of "entree." The dealers furnish a kind of wafer that answers well for most fishes; and we have found that goldfish, carp, minnows, and vegetable feeders in general are very fond of boiled rice. They eat it greedily,

and thrive upon it. The rice is boiled in water until quite soft, then drained nearly dry, and, of course, given when quite cold. The boiled rice-grains resemble grubs in appearance, and the fish make for them at once. One great advantage of boiled rice is that it has very little tendency to corrupt the water.

Aurum Musivum, or Mosaicum.— This compound early attracted the attention of the alchemists, who no doubt supposed, when they saw it come from their crucibles, that they had taken a long stride toward the discovery of the philosopher's stone, and that one step more would enable them to convert tin into veritable gold. So they called this strange gold-like compound *aurum musivum,* or mosaic gold. It is in reality a disulphide of tin, and is made as follows:—

1. Melt 12 oz. of tin and add to it 3 oz. of mercury; triturate this amalgam with 7 oz. of sulphur and 3 oz. or sal ammoniac. Put the powder into a mattrass,* bedded rather deep in sand, and keep it for several hours in a gentle heat, which is afterwards to be raised and continued for several hours longer. If the heat has been moderate, and not continued too long, the golden-colored, scaly, porous mass, called aurum musivum, will be found at the bottom of the vessel; but if it has been too strong, the aurum musivum fuses to a black mass, of a striated texture.

2. Melt together, in a crucible over a clear fire, equal parts of sulphur and the white oxide of tin. Keep them constantly stirred with the stem of an earthenware pipe or glass rod till they assume the appearance of a yellow flaky powder. In stirring the mixture avoid the use of an iron rod, as it would destroy the compound.

---

* A mattrass is a glass flask with a long neck. Any thin bottle of green glass will answer if it is bedded well in sand, so that it may not be exposed to sudden changes of temperature. We have made very fine mosaic gold in two common clay crucibles placed mouth to mouth and luted together. (See article *Lute.*) In the upper crucible we bored a small hole for the escape of vapors, and the whole was placed inside a larger crucible, the space between being filled with sand. No metallic vessel will answer.

Mosaic gold is used as a color or bronze for coating plaster-of-paris images, and also as a gold varnish on toys, and likewise for the sparkles or spangles in that which is called gold sealing-wax. Of late years, however, the manufacture of bronze-powders has been so much improved that they have driven the mosaic gold entirely out of the market. In the laboratory it is still used for coating the rubbers of electrical machines, as it produces powerful excitations, requires no grease, and does not stick to the glass.

Authorship.— Authorship consists of two distinct departments: first, the possession of good ideas; and second, the getting of them into a form fit for publication. In regard to the first, we can offer no help; but we would earnestly caution our readers against attempting to become authors until they have something really worth offering to the public. Young people, especially those who are inclined to write poetry, are most frequently sinners in this respect, though we must say that in too many cases it is more the fault of others than of themselves that they try to get into print. Impelled by a mere desire to put their thoughts on paper, and for their own gratification, they produce a piece of rhyme and show it to their friends, who all go into ecstasies over it and urge them to publish It is then submitted to the preacher and the teacher of the village, who both pronounce it finer than anything that Moore or Byron ever wrote, and forthwith it is sent to the editor of some paper. If the paper is published in a small place and has a small circulation, the editor will probably be glad to get it, not for its own sake, but because the friends of the poet will no doubt purchase a few copies, and he may even secure two or three new subscribers. The poor author is thus victimized and made to believe that he or she is a rising genius; and when other editors, having greater knowledge and free from personal bias, refuse the doggerel, which is sure to be thereafter copiously produced, it is claimed at once that such rejection arises from prejudice and all sorts of bad reasons. Now let it be borne in mind that it would prob-

ably be difficult to select three worse judges than the preacher, the teacher, and the editor, of a country village. In the first place, they are rarely able to form a sound judgment of anything out of their own special line. This is shown by the readiness with which their names are secured as endorsements to every claptrap that comes along. And in the second place, they are apt to be swayed by a desire to favor a friend and neighbor. Of course there may be marked exceptions, but in a pretty wide experience we have generally found it as stated.

Assuming, however, that you have something to say which the public is interested in hearing, the following hints will enable you to get your manuscript into presentable shape:—

1. Select a proper-sized paper, not very large nor very small, and never write on waste scraps. Ordinary commercial note-paper, which may be had cheaply in packages, is a very suitable size. Use single leaflets. Do not make your manuscript up into book-form, with the pages from the beginning to the end of the article attached to each other. Above all, carefully number each page consecutively.

2. Use a good black ink; pale ink or fancy colored inks are an abomination. The only exception to this is the use of dark violet ink. Ink of this kind dries rapidly, consequently it needs no blotter, and is liked much by some authors. There can be no objection to it.

3. Write only on one side of the paper.

4. Write a plain, bold hand, giving more attention to distinctness and legibility than to beauty. Remember that the manuscript will come back to you soiled and crumpled and fit only for the waste basket, while the printed copy may endure for ages, and an error caused by illegible manuscript may annoy yourself and friends years after your "beautiful" manuscript has been consumed by fire.

5. Leave ample margin on *one* side of each sheet for corrections.

6. See that the paper is wide ruled.

7. Use no abbreviations which are not to appear in print.

8. Punctuate the manuscript as it should be printed.

9. For *italics*, underscore with one line; for SMALL CAPITALS, with two lines; for CAPITALS, with three lines.

10. Never interline without the caret to show its place.

11. Take special pains with every letter in proper names.

12. Review every word, to be sure that none is illegible.

13. Put directions to the printer at the head of the first page.

14. Do not write long articles, or long sentences. Write as you would a telegram, where each word costs a dime; or as an advertisement which costs a dollar a line.

15. Do not ask an editor to return your manuscript. Keep a copy. With a hundred letters a day to read, he has something to do besides hunting up last year's manuscripts,—received, rejected, and buried or burned long ago.

16. Never write a private letter to the editor on the printer's copy, but always on a separate sheet.

Finally, do not say, "I write in a hurry; please correct all mistakes." You have ten times the opportunity to do this that the editor has. His time is worth from fifty cents to ten dollars an hour, and he will be likely to correct your errors by fire, and then they will never trouble any one any more. You must do your own work if you want it done. Some poor printer has to set up the type for your article. Every cent you save by using pale ink, poor paper, and writing carelessly because you are in a hurry, or writing finely, or crosswise, to save two cents postage, will cost the printer in toil, delay, and eyesight, at least fifty times as much money as you will save, besides causing him to commit blunders for you to scold about.

The above hints are specially intended for those who write for the periodicals of different kinds. Similar rules apply to the preparation of manuscript for books. See that the manuscript is perfect before it is placed in the hands of the compositor. Time is charged on all corrections, alterations, and additions made in the proof, which are not in the original

copy. A very little change takes up more time than is generally supposed. The insertion or removal of a word or two may require the overrunning of every line in a long paragraph; the adding or taking out of a sentence, the overrunning of every page set up which follows it. All this can be avoided by having the manuscript carefully prepared. The time-work charged on a badly prepared manuscript will often exceed the cost of having it fairly copied by a clerk.

Leave a wide margin, on which can be written directions for the compositor and minor corrections. Marginal corrections are preferable to interlineations. When they are too long to go in the margin write them on a separate piece of paper, marking it with the page, and indicating on the page the place where it is to be inserted. Write on the margin the amount of space, if any, desired between paragraphs or divisions, for the insertion of additional authorities, etc.

Attend to your own punctuation, marking each point distinctly. Remember the old craft-pun, that "compositors are setters, not pointers,"—their duty is to "follow copy." The whole force of a paragraph may be destroyed by careless punctuation.

Authors should always make the beginning of a new paragraph conspicuous to the compositor by indenting the first line of it far enough to distinguish it from the preceding line in case the latter should be quite full.

Make a final careful revision of the manuscript before handing it in. It is said that Newton wrote his chronology over fifteen times before he was satisfied with it; and Gibbon wrote out his memoir nine times before sending it to the press. No beginners can expect better success or less labor than such learned men.

Estimating Amount of Matter in Manuscript.— A tolerably close estimate of the words contained in even bad manuscript may be made by counting the lines of say twelve of its varying pages, then getting an average per line of the words in several lines taken from each page, and multiplying the number of

the former by that of the latter. Next add the average allowance for chapter-lines, sub-heads, and other break-lines, counting them as full lines. Reduce the break-lines to full lines, adding them to the whole, and you have the contents of twelve pages. Divide by twelve to find the contents of a single (average) page.

For example, a work of 400 pages in manuscript is submitted. Twelve average pages, taken at intervals, give an average of 30 lines to a folio. Three lines taken at various places from each of these twelve pages indicate an average of eleven words to a line. This will give about 330 words to a page, exclusive of breaks, chapter and other lines, for which an allowance is made of four lines, or 44 words, for each page of manuscript, which, added to 330, makes 374. Multiply the 374 words per page by the 400 pages in the manuscript, and you have a result of 149,600 words in all.

To know how many pages of printed matter this will make, it is now necessary to have the size of type and page to be used. An exact printed page, containing the one and representing the other, is always a good guide in completing the calculation, which is done by dividing the number of words contained in the manuscript by that of the printed page. This will give the desired cast-off for the work in printed pages.

Thus, the estimate of the manuscript gives 149,600 words; that of the printed page of the size required—set up in leaded long primer, we will say for example—gives 480 words; consequently 149,600 divided by 480 gives 312 pages, or 20 sheets, if printed in octavo.

When extra or more than single "leading" of matter is required, count the extra leads (six-to-pica being the size most used in book-composition) in the following proportions: three for a nonpareil line; four for brevier and bourgeois; five for long primer and small pica; six for pica; and so on, increasing or diminishing in the necessary ratio for larger or lesser sizes.

For works under 144 pages, the cast-off of which does not

reach a number of folios divisible by 4, there should be added the number that will make it so. Thus, 110 will be counted as 112; 134 as 136; and so on. A sufficient allowance of pages, added in the same way, should be made in cast-offs for larger works, adopting 8 or 12 as the even dividing number. This rule applies more particularly to works where the copy is very irregular or much crowded with abbreviations and closely written notes, alterations, interlines, etc.

Babbitt's Anti-attrition Metal.— This has long been a favorite alloy for forming bearings for the journals of shafts, etc. The large proportion of tin which it contains renders it essentially anti-friction, while the copper and antimony render it hard enough for light work. When the bearings have to carry a great weight, however, the Babbitt metal is too soft, and yields under the pressure. To keep it in place and give it strength enough, the inventor uses cast-iron boxes having one or more recesses or cups for the reception of the soft metal, which is not only cast in place, but so managed that it shall be literally brazed or soldered to the more rigid cast-iron. The following are the directions given by the inventor for preparing and using this metal:—

"In the first place, I melt four pounds of copper; and when melted, add by degrees twelve pounds best quality Banca tin; then add eight pounds regulus of antimony; and then twelve pounds more of tin, while the composition is in a melted state.

"After the copper is melted, and four or five pounds of tin have been added, the heat should be lowered to a dull red heat, in order to prevent oxidation; then add the remainder of the metal, as above named.

"In melting the composition, it is better to keep a small quantity of powdered charcoal in the pot, on the surface of the metal.

"I make the above composition in the first place, which I call hardening; then, as I want to use for lining-work, I take one pound of the hardening and melt with two pounds Banca

tin, which produces the lining-metal I now use, which I consider the best I have ever used. So that the proportions for lining-metal is four pounds copper, eight regulus of antimony, and ninety-six pounds tin.

"The object I have in first preparing the hardening, as above mentioned, is economy; for when the whole is melted together, I find there is a great waste of metal, as the hardening is melted at a much less degree of heat than the copper and antimony separately.

"I find, in my practice, that in melting the lining-metal, or tin for tinning the boxes, there is some oxidation on the surface of the metal, which should be skimmed off. This oxide I save, and, when I get a quantity, put it into a black-lead crucible, add about one tenth in bulk of pounded charcoal, expose it to a smart red heat, which brings it back again to metal fit for use.

"The box or article to be lined, having been cast with a recess for soft metal, is to be nicely fitted to a former, which is made the same shape as the bearing, except being a hair larger than the bearing.

"Drill a hole in the box for the reception of the metal, say half or three quarters of an inch, according to the size of the box. The box having been thus prepared, coat over the part not to be tinned with a clay wash; wet the part to be tinned with alcohol, and sprinkle on sal ammoniac, ground as fine as common table salt. Heat the box till a fume arises from the sal ammoniac, and immerse it in a kettle of Banca tin melted, care being taken not to heat it so that it oxidizes.

"After the box is tinned, should it have a colored appearance, sprinkle a little sal ammoniac, which will make it of a bright silver color, and cool it gradually in water; then take the former, to which the box has been fitted, and coat it over with a thin clay wash, and warm it so that it will be perfectly dry; heat the box until the tin begins to melt; lay it on the former and pour in the metal, which should not be so hot as to oxidize, giving the metal a head, so that as it shrinks up it

will fill up. After it is sufficiently cool take it off the former and scour the box, so that there may be no sand or dirt on it, which would injure the bearing.

"A shorter method may be adopted when the work is light enough to handle quickly, viz., when the box is prepared for tinning it may be immersed in the lining-metal instead of the tin, brushed lightly in order to remove the sal ammoniac from the surface, placed immediately on the former, and lined with the same heat."

Balloon.—As a means of aerial navigation, in the proper sense of that term, the balloon is now generally acknowledged to be useless or worse than useless; but as an instrument for observation, whether in the operations of war or the purposes of meteorology, it is of great value. And as small captive balloons are easily constructed, at small expense, they will no doubt come into more general use in the future. A balloon eight feet in diameter, filled with gas, will carry up quite a number of efficient instruments for recording temperature, pressure, electrical condition, etc.

The art of ballooning depends upon the difference between the weights of the same bulk of air and that of some of the lighter gases. Thus pure hydrogen, weighed under similar conditions, is about 16 times lighter than common air; but when prepared on the large scale, and containing water, air, and other impurities, it is only from 7 to 11 times lighter than the atmosphere. A cubic foot of atmospheric air at the level of the sea weighs .07609 lb.; a similar globe of hydrogen (reckoning it only as 6 times lighter than common air), will therefore have an ascensional force of .063 lb., or rather more than an ounce. Now, the weight of the body of air which a balloon displaces must exceed the gross weight of the balloon, its contents, and all its appendages, in order for the latter to ascend in the atmosphere. The difference of the two weights expresses the ascensional force. In round numbers the buoyancy of a balloon may be reckoned as equal to 1 oz. for every cubic foot of hydrogen it contains, *less* the weight of the case and

appendages. The carburetted hydrogen supplied by the gas-works is much heavier than hydrogen gas, and consequently much less buoyant, for which due allowance must be made. That which possesses the least illuminating power is the lightest, and consequently best adapted for aerostation.

The aerostatic power of balloons is proportional to their dimensions in the ratio of their contents, and this is as the ratio of the cubes of their diameters. Thus it will be found that a balloon of 60 feet diameter filled with common hydrogen will ascend with a weight of nearly 7,000 lbs., besides the gas-case, whilst one of only 1½ foot in diameter will barely float, owing to the less proportionate volume of gas to the weight of the case containing it.

The following table shows the relations between the diameters, surfaces, and capacities of spheres:—

Diameters.	Surfaces.	Cubical contents.
1	3·141	·523
2	12·567	4·188
3	28·274	14·137
4	50·265	33·51
5	78·54	65·45
10	314·159	523·6
15	706·9	1767·1
20	1256·6	4189·
25	1963·5	8181·
30	2827·	14137·
40	5026·	33510·

The fabric of which the cases of air-balloons are made is strong thin silk, covered with an elastic varnish of drying oil or india-rubber, or, what is better, a solution of india-rubber in either chloroform or bisulphide of carbon; the netting is of strong light silk or flaxen cord, and the car of basket-work. Fire-balloons, on the small scale, are generally made of tissue-paper, and are inflated with the fumes of burning alcohol, by means of a sponge dipped in that liquid and suspended just within the mouth of the apparatus.

Owing to the increasing rarity of the atmosphere as we

ascend from the earth's surface, balloon-cases are made very much larger than is required to contain the necessary quantity of gas, to allow for its expansion as it rises into a rarer medium. A cubical foot of gas measured at the level of the sea occupies a space of two feet at an elevation of 3½ miles.

Soap-bubble Balloons.—M. Delon, of Paris, produces miniature balloons by means of ordinary gas conducted through a caoutchouc tube and clay pipe to glycerine soap solution. A small disk of thin paper, with fine wire from its center to a little paper car with aeronaut figures, is connected to the bubble when it begins to swell, the disk being attached by capillarity to the part where the drop forms. The detached bubble rises with its car.

Bast.— Bast, or bass, is the inner bark of various species of the linden. It is used in Europe (chiefly in Russia) largely for manufacturing mats, which form a most excellent protective covering for plants, etc., securing them against frost and cold. It is also used quite extensively in horticulture for tying up plants and for binding grafts, etc. Its soft ribbon-like character renders it peculiarly valuable for this purpose,— far superior to twine, osiers, etc.

A very excellent article of bast may be obtained from the basswood of this country. The outer bark having been stripped off and soaked in water, the inner bark separates in long ribbons, which are then dried and stored away for use.

Bedbugs.— Bedbugs are not only disgusting and annoying, but absolutely dangerous, as their bites and poison have been known to cause severe fevers in persons of sensitive organization. Some persons seem to be perfectly proof against them; others seem to attract these vermin so strongly that if there should be a single bug in the house in which they sleep they are sure to be bitten. And while it is true that under ordinary conditions the tidy and industrious housewife finds no difficulty in keeping her rooms and furniture free from them, yet it is equally true that there are occasions on which the most expert will have their powers and ingenuity taxed to the utmost.

Such occasions arise when from long immunity the housekeeper feels secure and allows her vigilance to relax; then a few prolific specimens are introduced by some accident, and before the family is aware of the trouble certain rooms and even the whole house will be overrun with them. Under such circumstances thorough and vigorous work will be needed; and to secure efficiency it is necessary in this as in every other case in which we have to deal with vermin that we should be thoroughly informed as to their habits and life-history.

English authorities claim that the bedbug is a native of America, and that it was not known in London prior to the great fire which destroyed that city. It is further said that the bug was introduced in the wood used to construct the new dwellings. Linnæus also was of the opinion that the bedbug is a native of America. In Mather's Bible that passage in the Psalms which, in our version, reads "Thou shalt not be afraid of the terror by night" is translated "Thou shalt not nede to be afraid of any bugs by night." The word "bug" here means bugbear.

It has been generally supposed that bedbugs are partial to old houses, but Westwood tells us that "it is certain that they swarm in the American timber employed in the construction of new houses; and it is said that they feed upon the sap of that wood." We ourselves have frequently found them in the woods in the bark of pine timber, far from any human habitation.

The eggs of the bedbug are white, of an oval form, slightly narrowed at one end, and terminated by a cap which breaks off when the young escape. These eggs are most beautiful objects under the microscope. The young are very small, white, and transparent, so that the circulation of the blood is easily seen in the insect at this stage.

There seems to be quite a difference of opinion as to the length of time that they can exist without food. Dufour says they live but a short time; De Geer tells us that he has kept full-grown specimens for more than a year in a sealed-up

bottle without food. We never could succeed in keeping them as long as that; but since they can subsist on various vegetable matters no one need have any hope of starving them out. The only way to get rid of them when they have got a foothold, and to keep rid of them, is to destroy every specimen that can be found. Fortunately this is not a very difficult task.

There are several very efficient methods of destroying bed-bugs, and we shall describe them in the order of their efficiency.

Fumigation with Sulphur Fumes.—This is decidedly the most effective method, though it involves more trouble than any other, and is more liable to produce injury. To fumigate a house or room, all the valuable furniture and everything that can be injured by the acid fumes must be removed, and all crevices must be stopped up so that the gas can not escape until it has done its work. Then a good fire is made in a small portable stove, which should be placed on bricks or on a large board well covered with earth. When the fire is at its best,—that is to say, when the fuel has been thoroughly ignited,—lay on a few pieces of roll brimstone and immediately leave the room, closing the door tightly. In a few hours the acid vapors will have penetrated every hole and crevice; and all animal life, from the rat or mouse to the disease-germ, will have been destroyed. Rats and mice, however, generally run away; but insects remain and are killed. As soon as the fumes have done their work the room should be thoroughly ventilated and cleaned.

The objections to the use of sulphur fumes in a house are that they destroy colors, cause metals to rust, and are generally injurious. All metals that can not be removed should be covered with paraffine-paper, and the keyholes should likewise be covered, and if the bugs have got into the locks remove them. For these obvious reasons this method should be used only as a means of last resort. Fortunately we have other agents nearly as good.

Corrosive Sublimate.— Corrosive sublimate, or bichloride of mercury, is probably the most effective poison that we have. For ordinary purposes it is used in solution in water; but as water does not readily moisten dusty or oily spots, a solution in alcohol is far superior. Dissolve an ounce of sublimate in a quart of alcohol, and brush this over cracks, joints, and any other inaccessible retreat of the bugs. The liquid will penetrate into joints and crevices at once, and, which is of more importance, the alcohol will carry the poison into the eggs of these vermin and thus destroy the young. One or two thorough applications will destroy every vestige of these pests.

Remember that this solution is a rank poison, and it should be kept out of the way of children and animals.

Various other solutions have been recommended, but they are all so far inferior to the bichloride that it would be a waste of space to name them. The alcoholic solution of the sublimate does not injure anything except varnishes and metals. Therefore it should not be applied to them. For varnished surfaces use a strong decoction of tobacco in water.

The following is the common formula for compounding "bug-poison":—

Corrosive sublimate (in powder) and hydrochloric acid, of each 1 oz.; hot water, ¾ pint; agitate them together until the first is completely dissolved. It is applied with a paint-brush, observing to rub it well into the cracks and joints. This is the common "bug-wash" of the shops. It is a deadly poison.

Gray, in his "Supplement to the Pharmacopœia," gives the following recipes:—

1. Alcohol, 1 pint; camphor, 2 oz.; oil of turpentine, 4 oz.; corrosive sublimate, 1 oz. Mix.

2. Olive oil, 8 oz.; oil of turpentine and beeswax, of each 2 oz.; sal ammoniac, arsenic, and corrosive sublimate, of each 1 oz. Melt the wax and oils together, and then stir in the other ingredients, in powder, stirring until the mixture is cold.

Insect Powder.— The least offensive and injurious application is the ordinary insect powder. When thoroughly applied

it is very effective, but it does not seem to destroy the young insects in the eggs; and therefore to make thorough work we must use a series of applications, so as to destroy the young broods as fast as they appear.

Having once got rid of them every care should be taken to prevent their reappearance. The most effective way of doing this is to remove all old and loose paper from the walls, and see that all crevices are filled up with good hard putty, which should be lime for walls and hard putty for woodwork. The woodwork and also the walls should be well painted with good oil paint, and special pains should be taken to see that the cracks in the floor are well stopped. Then, with vigilance and plenty of good soap and water the housekeeper may bid defiance to "the terror that walketh by night."

Birch-bark (Oil of).— It has long been a well-known fact that Russia leather owes its durability, as well as its peculiar odor, to the oil of birch-bark, with which it is dressed. The whole process seems to be pretty well understood, and has been for a long time,— the great difficulty in the way being the labor required in the preparation of the oil. It is only from the thin paper-like bark of the birch that the oil can be procured; the wood and the coarser bark of the birch yield only a stinking oil, totally unlike the oil of the external bark. Gray, in his "Operative Chemist," describes the process of preparing this oil, as follows:—

The Russians obtain this oil by filling a large earthen pot with the thin, whitish, paper-like external bark of the birch tree, carefully separated from the coarse bark, closing the mouth of this pot with a wooden bung pierced with several holes; and then turning it over and luting it with clay to the mouth of another of the same size. A hole being dug in the ground, the empty pot is buried in it and a fire is lighted round and over the pot containing the bark, which is continued for some hours, according to the size of the pot. When the apparatus is cooled and unluted, the lower pot contains the brown

oil, mixed with pyroligneous tar, and swimming on an acid liquid.

In some places iron pots are used for this purpose, and the bark is hindered from falling into the lower pot by a plate of iron pierced with holes. Gray says that one hundred pounds of bark yield about sixty pounds of oil.

The waste of fuel in this process might be avoided by placing the pots in the side chamber of a reverberatory furnace, filling the chamber a little above the joining of the pots with sand, and then proceeding to distillation.

This oil is used in Russia for currying leather, to which it gives a peculiar odor and a power of resisting moisture far beyond any other dressing. Its use seems to have arisen from observing that the thin paper-like leaves of birch-bark remained after the coarser part of the bark and the timber of fallen trees had rotted. The oil appears to owe this quality to a resin, which, by this mode of distilling *per descensum*, is allowed to escape in a great measure from the action of the fire and drop into the lower pot.

Other barks—as those of the oak, willow, poplar, alder, as also poplar-buds, rue, and savine—have been tried, but the produce from them was only a stinking oil. Cork yielded an oil approaching, in some degree, that of birch-bark.

The genuine Russian birch-oil has been imported into this country, and has given very good results in the dressing of American leather.

Birdlime.—This preparation is used extensively by professional birdcatchers, and affords a very simple and effectual method of capturing small birds without injuring them. Twigs or small rods are coated with birdlime, and placed either near some food or over a cage containing another bird. In either case the wild bird is sure to hop on to the limed twig, and will be held until the birdcatcher secures him.

Good birdlime is greenish colored; very gluey, stringy, and tenacious; when air-dried it is brittle and pulverizable, but

capable of gradually assuming its previous viscosity when moistened.

To prepare it the middle bark of the holly (gathered in June or July) is boiled from six to eight hours in water, or until it becomes quite soft and tender. The water is then drained off, and it is placed in a heap in a pit under ground (commonly on layers of fern) and covered with stones. Here it is left to ferment for two or three weeks, and watered, if necessary, until it assumes a mucilaginous state. It is next pounded in a mortar until reduced to a uniform mass, which is then well kneaded with the hands in running water until all the refuse matter is worked out. It is, lastly, placed in an earthen vessel and covered with a little water, in which state it may be preserved from season to season. In about a week it is fit for use.

Brunswick Black.— This is a black varnish which is a favorite with microscopists and amateurs. Being cheap it is also used to blacken ironwork, grates, etc. The formula for the best article is as follows:—

In an iron pot, over a slow fire, boil 45 lbs. of real asphaltum (not that made from gas-tar) for six hours; and during the same time boil in another iron pot 6 gallons of oil which has been previously boiled. During the boiling of the 6 gallons introduce 6 lbs. of litharge gradually, and boil until it feels stringy between the fingers; then ladle or pour it into the pot containing the boiling asphaltum. Let the mixture boil until upon trial it will roll into hard pills; then let it cool, and mix it with 25 gallons of turpentine, or until it is of a proper consistence.

Bladders.— To the amateur chemist bladders often form an efficient substitute for a much more expensive apparatus. They form the cheapest and most convenient gasholders that can be obtained; and we have often melted platinum, burned small pieces of iron, and even produced a good lime-light by means of two bladders and some very simple home-made apparatus. Strips of bladder, after being moistened, adhere

firmly to glass and metal in drying, and often form the best joints and lutes in putting pieces of apparatus together. And in certain physical experiments on liquids, pieces of bladder are as convenient an article as can be used.

Bladders are prepared by being first freed from all fat and flesh. This is best done by blowing them up and removing all superfluous matter with a sharp knife, the utmost care being taken to avoid cutting the bladder itself, since the least puncture renders the bladder worthless. It is always well to expand the bladder a little first, as if we begin to cut while the bladder is thick and unexpanded the danger of cutting the bladder itself is greatly increased. The bladder should then be soaked in a weak solution of common washing soda and well washed, after which it is blown up as tightly as possible, and the neck firmly tied. It is now to be rolled and worked with the hands on a smooth board or table, and as fast as it gets larger so that the air does not keep it tight, it must be blown up again. The use of a bladder-tube and stop-cock greatly facilitates this operation, as the bladder can then be frequently filled without the trouble of tying and untying the neck. The blowing up of a large bladder is a somewhat tedious operation, but it is astonishing to see the extent to which it may be increased in size. After being blown as large as possible, the bladder should be filled with water and emptied two or three times, so as to wash out the inside. This tends greatly to prevent putrefaction. After being thoroughly washed the bladder should be soaked in a weak solution of chloride of lime, or, better still, Javelle water. It should then be thoroughly emptied, blown up tight, and tied. If now well dried, it will keep in good condition for any length of time. The great difficulty with bladders when used for such purposes is that they can not be used in a dry state, and they soon become putrid if exposed to alternate wetting and drying. This difficulty may be avoided in a great measure by soaking the bladders in a solution of salicylic acid in glycerine. This not only preserves them but keeps them soft and pliable, so that they

may be used quite readily for experiments on gases. By careful selection and thorough work in preparing and expanding the membrane a good-sized ox-bladder may be converted into a very serviceable gasholder.

Cadmium.— This metal would be of great use in the arts if it were not so rare. In many of its properties it stands between zinc and tin. The color and metallic luster of cadmium are similar to those of tin: it is ductile and malleable, but more readily acted upon by atmospheric oxygen and moisture than tin.

But the prominent feature of cadmium is its low fusing point, and the fact that it forms with lead, tin, and bismuth, alloys which have a lower melting point than any other metal except mercury. (See *Fusible Metals.*) It is said that a beautiful white metal, very hard, and capable of taking a brilliant polish, is obtained by melting together about seventy parts of copper, twenty of nickel, five and a half of zinc, and four and a half of cadmium. It is, therefore, a kind of German silver, in which part of the zinc is replaced by cadmium. This alloy has been recently made in Paris for the manufacture of spoons and forks, which resemble articles of silver.

The great facility with which cadmium volatilizes has been the serious drawback to the formation of its alloys and their study.

Cadmium also furnishes a beautiful yellow paint—cadmium yellow,— which is a sulphuret of cadmium.

Cameos.— Success in the cutting of cameos will depend largely upon the artistic abilities of the carver. In skillful hands the results are exceedingly delicate and beautiful. The following is the method of working:—

Take the common helmet or the red helmet shell (those shells whose inner surface is pink or dark colored are most suitable), cut them into squares with a lapidary's mill, round off the corners, and shape them into an oval on a wet grindstone. Fix the enamel side on a short stick with jeweler's cement, grind off the brittle surface, sketch the subject with

a black-lead pencil, cut the subject with engraver's tools, namely, a chisel-tool to clear the bare places; a lozenge-shape for forming the subject, and a scraper made of a three-angled file, ground off taper to the point, for cleaning the enamel surface round the subject, and also for forming the lineaments and other delicate parts. The color on the cheeks and hair is produced by leaving the layer of colored shell on those places. The stick must be grasped in the left hand, and held firmly against a steady bench, and with the tool resting in the hollow of the right hand, dig away the shell. A convenient length for the tools is three inches and a half; they must be kept in good condition to work with accuracy. The cameos are polished with a cedar stick, or a piece of cork dipped in oil of vitriol and putty-powder, and cleaned with soap and water. Mother-of-pearl is carved in the same way.

Casehardening.—There are few subjects which have afforded a more profitable field to the traveling recipe-monger than iron and steel, especially as relates to welding and casehardening. The latter is a very old process, but one which still has important uses, notwithstanding the great improvements in the manufacture of iron and steel.

Casehardening is simply the rapid conversion of the surface of a piece of iron into steel, and this is usually followed by sudden hardening in cold water, which makes the casehardened portion as hard as the hardest steel, and besides gives it a beautifully mottled appearance. The special advantage possessed by an article which has been casehardened over one made entirely of steel lies in the fact that the interior or core remains soft and tough, so that the article is not liable to be broken by a fall or a blow. Owing to the irregularity of the steelifying process the surface also presents a mottled appearance, which confers upon it a beauty that can not be obtained in any other way.

The following processes have been tested by experience, and may be fully relied upon:—

1. Where it is desired that the articles should be hardened

to a considerable depth: Char a quantity of bones, just enough (*and no more*) to enable you to powder them with a hammer. Lay a layer of this bone-dust over the bottom of an iron tray or box, which may be easily made by bending heavy sheet-iron into form. Lay the articles to be hardened on the bone-dust, taking care that they do not touch each other. Cover with bone-dust, and fill up the tray with spent dust, charcoal, or sand. Expose to a bright cherry-red heat for half an hour or an hour, and then turn the entire contents of the tray into a vessel of cold water. We have seen beautiful results obtained by this process when carried out in a common kitchen-stove.

Even raw bone-dust, such as is sold for farming purposes, may be used with good results.

Bone-black or ivory-black may also be used; and, as they may be purchased ready prepared, we may avoid the disagreeable process of roasting the raw material.

2. Moxon's recipe is as follows:—

Cow's horn or hoof is baked or thoroughly dried and pulverized. To this is added an equal quantity of bay salt, and the whole is made into a paste with stale chamber-lye or white-wine vinegar. The iron is covered with this mixture, and bedded in it, in loam, or inclosed in an iron box. In this form it is laid on the hearth of the forge to dry and harden; then it is put into the fire, and blown till the lump has a blood-red heat (no higher). It is hardened by immersion in water or oil, the latter being preferred for delicate articles.

3. Take a quantity of old boots, burn these until they become charred, beat off the black and charred portion with a hammer until sufficient powdered carbon is obtained. Then place this powder with the articles to be operated upon into a sheet-iron box or a piece of wrought-iron gas-pipe sufficiently large, taking care that the articles are well covered and in the center of the mass; lute the ends of the pipe or the top of the box with clay, and place the whole into a fire made of coke, keeping them there for an hour or more, taking care that the

heat shall be equal (between dark-red and red); now plunge the contents into water.

Any animal matter will answer; and, on the large scale, charcoal might be prepared from almost any refuse of the kind; and, being well powdered, might be made an article of commerce. "Charcoal for casehardening" could hardly fail to find a good market.

It would seem that in mechanical processes, as in medicines, there are those who believe that the more disgusting an article is the more effective it is. It is only on this ground that such filthy ingredients as stale urine, nightsoil, etc., can have been recommended. We have tried these abominable recipes, and they are not as efficient as the more cleanly ones. We therefore omit them.

4. As this roasting of bones, leather, etc., gives rise to most abominable odors, the editor of this work some years ago devised the following preparation, which was found to give very excellent results:—

Prepare a strong solution of prussiate of potassa ; boil in it as much coarsely powdered wood-charcoal as can be mixed with it. Drain off the superfluous liquid, spread the charcoal on a board, and dry by exposure to the air. When dry, roast it at a temperature just below that of ignition, the object being to drive off all moisture, but not to discompose the prussiate, which, at a red heat, is converted into cyanide of potassium and some other compounds. The charcoal thus prepared, and afterwards reduced to a moderately fine powder, will be found to answer quiet as well as animal-charcoal; and no difficulty will be found in casehardening to a depth which will allow of a good deal of polishing before the soft metal underneath is reached.

In using the materials above described, the articles to be casehardened are always inclosed in an iron box or case while exposed to the fire. Pieces of iron tubing make capital receptacles to hold the work, the ends being stopped with loose

iron plugs, which are to be cemented in air-tight with a mixture of fire-clay and sand, and the whole securely bound with wire. The entire outside of the box or tube should then be coated with loam and allowed to dry, after which it may be exposed to a fire for a period varying from half an hour to three hours, according to the size of the box and the design of the operator.

In packing the articles in the box see that the entire space is packed solidly with the powdered charcoal; and, above all, see that none of the pieces touch each other. The air must be thoroughly excluded, or mischief will ensue.

The articles are usually hardened by allowing them to drop directly from the box or tube into a tub of water, in which they are vigorously stirred until cold. For some peculiar purposes the articles are dropped into oil. They do not become so hard, but they are tougher.

When mere superficial hardening is required, heat the article to be hardened to a bright red; sprinkle it liberally with powdered prussiate of potash. The salt will fuse, and if the piece of iron is small and gets cooled, heat it again and plunge into cold water.

We have seen recipes in which various salts (sal ammoniac, nitre, and even bichromate of potassa!) are recommended to be mixed with the prussiate of potash. It is needless to say that such additions do harm instead of good, and can only serve to render the recipe more complicated and mysterious. The fact is, however, that casehardening is one of those operations which are usually surrounded by much mystery by the less intelligent class of mechanics; but to those who have given the subject a careful practical study the process is as well understood as any other operation connected with iron and steel. Even where we would least expect it, this nonsensical complication creeps out. Thus, in a "Techno-chemical Receipt-book" recently issued we find the following as the only recipe given in this department:—

"*New Casehardening Compound.*—This compound is very efficacious for casehardening iron. It consists of 16 parts of lampblack, 18 of sal soda, 4 of muriate of soda, and 1 of black oxide of manganese."

This recipe is almost worthless. The lampblack is the only efficient agent present, and it is not half as good as charred leather or bone-black.

Should the articles require to be blue, such as the barrels or chambers of pistols, repolish them on an emery-wheel; put them into a sand-bath or powdered charcoal, and heat until the blue color is attained, taking them out the instant that this change takes place. It should be borne in mind that articles treated in this way are comparatively soft.

Owing to the extreme hardness of their surface, articles that have been casehardened are capable of taking a very high polish. The ordinary processes of polishing and buffing are sufficient to produce beautiful results.

Articles which have been casehardened may be annealed and made so soft as to be readily worked with files and turning tools, and they may be again hardened so that those parts from which the steely surface has not been removed will be as durable as ever. Of this principle advantage has been taken to cause the casehardening to terminate at any desired point. The article is left with a band or projection at the place which is desired to be soft; the work is allowed to cool without being immersed in water; the band or projection is now removed by turning or filing, and the work when hardened in the open fire is only affected so far as the original cemented surface remains. This ingenious method was introduced by Mr. Roberts, of Manchester, who considers the success of the casehardening process to depend on the gentle application of the heat. Mr. Roberts thinks that by proper management, so as not to overheat the work, the cementation may be made to penetrate three-eighths of an inch in four or five hours. "In the general way, the conversion of the iron into steel by casehardening is quite superficial, and does not exceed the one-sixteenth of an

inch. If made to extend to one-quarter or three-eighths of an inch in depth, to say the least it would be generally useless, as the object is to obtain durability of surface with strength of interior, and this would disproportionately encroach on the strong iron within. The steel obtained in this adventitious manner is not equal in strength to that converted and hammered in the usual way; and if sent in so deeply, the provision for wear would far exceed that which is required."–*Holtzappfel.*

By combining a hard steely surface with a soft interior, the article is enabled to resist sharp blows as well as wear. If left soft, it is easily worn down by friction; if hardened throughout, it will break like glass by a mere fall.

Casehardening Powders.— Several powders have been placed on market for the purpose of casehardening. The principles to be adopted in compounding them will be obvious from what we have just written. The following are a few of the best:—

1. Prussiate of potash, dried, finely powdered, and mixed with any simple coloring-matter to disguise its appearance.

2. Prussiate of potash, 3 parts; sal ammoniac, 1 part. Powder finely, and mix thoroughly. A little very finely powdered animal-charcoal is sometimes added.

3. Sal ammoniac and bone-dust, of each 2 parts; prussiate of potash, 1 part. Grind to fine powder, and mix thoroughly.

4. The powder suggested by the author of this work, namely, animal charcoal, soaked in a solution of prussiate of potash and finely powdered, we believe to be the most convenient and efficient. It is cheap, easily made, and, if put up in packets of different sizes, would find a ready though limited sale.

Castings and Patterns.— There are few problems more interesting to the pattern-maker than the determination of the weight of the castings which his patterns will produce. Some years ago the author investigated this subject very carefully, both theoretically and experimentally, and published the results in the first volume of *The Manufacturer and Builder*, of which he was editor.

The relative weight of patterns and castings can, of course, always be determined most accurately by measuring the pattern and multiplying the number of cubic inches which it contains by the weight of a cubic inch of the metal of which the casting is to be made. The weight of a cubic inch of the various metals in common use may be found in any table of specific gravities. This plan should always be adopted in the case of very large castings, because it eliminates several important sources of error; and when proper allowance is made for shrinkage it gives results which are very near the truth. But many patterns, especially those of small size, are so irregular in shape that accurate measurement is tedious if not difficult. In such cases a tolerable approximation may be obtained by weighing the pattern, and comparing this weight with the weight of the same bulk of the material of which the casting is to be made. If the specific gravity of all samples of the same kind of wood were alike, and if the casting were always the same size as the pattern and of uniform specific gravity, this method would be perfectly accurate. But even with every drawback it gives tolerable approximations.

In the following table we give a series of multipliers which express the relative weight of patterns of different materials when cast in different metals. To find how much a casting from a given pattern will weigh proceed as follows:—

Weigh the pattern. Then in the first column find the material of which the pattern is made, and opposite this and under the material of which the casting is to be made will be found a number which when multiplied by the weight of the pattern will give the weight of the casting.

Example: A pattern made of St. Domingo mahogany weighs 8 lbs. 6 oz. How much will a casting of iron weigh?

Weight of pattern, ...	8 lbs. 6 oz.
Multiplier for cast-iron set opposite St. Domingo mahogany, ...	10
Weight of casting, ...	83 lbs. 12 oz.

TABLE OF MULTIPLIERS FOR FINDING THE WEIGHT OF CASTINGS FROM PATTERNS.

Material of Pattern.	Specific Gravity.	Cast Iron.	Gun Metal.	Yellow Brass.	Zinc.	Copper.
Mahogany, . . .	·854	8	10	9·8	8	10·2
St. Domingo do. .	·700	10	12	11·5	9·5	12·2
Maple, ...	·700	10	12·4	12	9·8	12·5
Beech, ...	·624	11	13·8	13·4	11	14
Cedar, ...	·596	11·5	14·5	14·	11·4	14·7
Yellow Pine, . . .	·541	13	16	15·5	12·6	16·2
White Pine, . . .	·473	14·2	17·8	17	14·5	18

The causes of error are: shrinkage in the castings; weight of nails and screws in the pattern; variation in specific gravity of material of which pattern is made; variation of specific gravity of metal of which casting is made. Shrinkage is too large an element to be left out of consideration, and we have diminished our multipliers by a proper proportion to allow for it. In the construction of patterns an allowance is usually made for this contraction, either by calculation or by the use of a shrinkage rule as it is called,—that is, a rule on which $12\frac{1}{8}$ inches is called a foot, and divided accordingly. But in making allowance for shrinkage in casting, pattern-makers understand that different shapes will shrink differently. The standard table of allowance for shrinkage in use in the best shops of the country is as follows:—

For Loam Castings,	$\frac{1}{12}$	inch per foot.
" Green Sand Castings,	$\frac{1}{10}$	" " "
" Dry " "	$\frac{1}{10}$	" " "
" Brass Castings,	$\frac{3}{16}$	" " "
" Copper "	$\frac{3}{16}$	" " "
" Bismuth "	$\frac{5}{32}$	" " "
" Tin "	$\frac{1}{4}$	" " "
" Zinc "	$\frac{5}{16}$	" " "
" Lead "	$\frac{5}{16}$	" " "

When cores are to be used a suitable allowance must be made for them, but this is in general most easily and accu-

rately done by measuring the cubic contents of the hole left by the core and calculating the proper weight to be deducted.

A singular oversight occurs in one of our architects' "Pocket-books" in the treatment of this problem. The reader is directed to use a series of multipliers which are arranged for the metal of which the casting is to be made, utterly irrespective of the material of which the pattern is made!

Chamois.— The chamois of commerce is a variety of soft pliable leather obtained by tanning the skin of the animal of the same name belonging to the antelope species. The leather is used extensively for burnishing metals, jewelry, glass, precious stones, silverware, fine woods, etc., and also in some cases for linings, and as a filling in or pack for surgical instruments. A great deal of the leather sold in the shops is nothing but finely tanned sheepskin; but this is not nearly so soft or strong as the genuine article, although it is held at the extreme prices asked for the imported and real chamois-leather.

The animal known as the chamois chiefly inhabits the Alps and the Pyrenees Mountains in Europe, being found in flocks of from half a dozen up to a hundred in number. It is of an exceedingly wild nature, and has never been domesticated.

Chamois may be cleaned in a weak solution of soda in warm water. Rub plenty of soft soap into the leather, and allow it to soak for two hours. Then rub it well until it is quite clean, and rinse it well in a weak solution composed of soda, yellow soap, and warm water. If rinsed in water only, it becomes hard when dry, and unfit for use. After rinsing, wring it well in a coarse towel, and dry quickly. Then pull it about and brush it well, and it will become softer and better than most new leathers.

The chamois-skin used for wiping delicate articles should be carefully protected from dust and any hard foreign particles which are liable to scratch the highly polished surface of gold, silver, or glass.

Court-plaster.— This is a very convenient application for slight wounds or cuts, and is easily made. It is found of

various colors, chiefly black and flesh-colored; and this depends altogether upon the color of the silk used, though if only white silk were at hand it would be easy to color it slightly with a little alkanet, or any other vegetable coloring-matter. The following formula gives good results:—

Soak isinglass in a little warm water for 24 hours; then evaporate nearly all the water by gentle heat; dissolve the residue in a little proof spirits of wine (alcohol of 85 per cent), and strain the whole through a piece of open linen. The strained mass should be a stiff jelly when cool. Now stretch a piece of silk or sarsanet on a wooden frame, and fix it tight with tacks or packthread. Melt the jelly, and apply it to the silk thinly and evenly with a badger-hair or any very fine brush. A second coating must be applied when the first has dried, and in some cases even a third is given. When thoroughly dry, apply over the whole surface two or three coatings of balsam of Peru.

Plaster thus made is said to be very pliable, and never breaks. The quality of court-plaster depends upon the quality of the silk used, and also upon the care taken to exclude all irritating and poisonous matter. Many of the dyed silks are absolutely poisonous; and if the isinglass is kept too long in water, so as to become tainted, it may cause serious injury.

Crucible.—This important instrument is used alike by the scientific metallurgist, the practical founder, and the amateur. The shape of the crucible and the material of which it is made vary very much, the selection of a suitable article depending upon the nature of the substance to be heated, and particularly of the flux used. Black-lead crucibles are largely used for melting metals, common and precious. Good crucibles of this material withstand sudden changes of temperature, and may be used over and over again, and the smoothness of their surface obviates one great source of loss, as the particles of melted metal do not adhere to the sides.

The metals employed for making crucibles are platinum, gold, silver, and iron. Platinum resists intense heat, but is

easily acted upon by caustic alkalies and by the fusible metals, or any compound from which they may be reduced. Gold is too expensive for crucibles, except in important and delicate experiments. Silver crucibles and dishes are used for fusing caustic alkalies. Crucibles of iron are used for roasting many chemical solutions; and they are also used for melting the more fusible metals, such as lead, zinc, tin, etc.

It will rarely pay the amateur to try to make a crucible, as they can be bought so easily and cheaply; but sometimes it may be found necessary to do so. The material will, in general, be some refractory kind of clay,—good fire-clay answering well. Where no very high degree of heat is to be employed, the clay may be mixed with sand; but if the crucible is to be exposed to a very high temperature the mixture of sand and clay will soften, if it does not actually melt. In such cases coarsely powdered fire-brick or old crucibles should be substituted for sand.

The materials, having been ground and kneaded, are generally molded by hand upon a wooden block of the shape of the cavity of the crucible. Another method of shaping a crucible consists in ramming the ingredients into a suitable mold, formed of steel or gun-metal.

A writer in the *Journal of the Society of Arts* has devised a very neat and expeditious method of forming small crucibles by pouring "slip," that is, clay mixed with sufficient water to give it the consistence of cream, into porous molds, made of plaster of Paris. A series of these molds are placed upon a table and filled with the semifluid composition. By the time the whole (say 50 or 60) are filled, the "slip" may be poured out of the one first filled, leaving only a very small quantity behind to give the requisite thickness to the bottom. The second and third may then be treated in the same way, until the whole number has been attended to. In each mold a perfect crucible is formed by the abstraction of the water of that portion of the "slip" in immediate contact with the plaster; and the crucible is either thicker or thinner in pro-

portion to the time this absorbent action has been allowed to go on. Seventy or eighty crucibles may thus be easily made in less than fifteen minutes. The molds and their contents are next placed in a stove or slow oven. In a short time, from the contraction of the clay in drying, the crucibles may be removed; and the molds, as soon as they have become dry, may be again filled. By care they will last for years.

The amateur chemist will often find that the bowl of a tobacco-pipe will make a very good crucible. The hole at the bottom should be well plugged with a little of the ground tobacco-pipe made into a paste with pipeclay and water.

Diamond.— Diamond-dust may be bought in most large cities ready prepared. It is not a very costly article, as it is made of waste pieces obtained in cutting jewels, and a little of it lasts a long time.

Diamond-mills, as they are called, are made either of brass or iron. The mill, having been turned to proper shape, is laid firmly on some solid substance, and the face that is to be impregnated with diamond-dust is slightly oiled. The dust is then sprinkled thinly over it and tapped lightly with a smooth hammer till the diamond-dust is thoroughly driven into the brass. The brass will bur around it, and hold it securely in place. The oil is used to prevent the dust from bounding off while undergoing the process of hammering.

Files and broaches may be made in the same way. They will cut the hardest material. Polishing broaches are usually made of ivory, and used with diamond-dust loose instead of being driven in. Oil the broach lightly, dip it into the finest diamond-dust, and proceed to use it as you would a brass broach.

Dubbing.— This term is applied to various greasy compounds employed by curriers and shoemakers for softening and preserving leather.

1. Cuttings of sheepskins boiled in cod-oil. Said to be used by curriers.

2. Black resin, 2 oz.; tallow, 1 lb.; crude cod-oil or train-oil, 1 gallon. Boil until the tallow and resin are thoroughly dissolved and mixed.

3. Any good fish-oil or tallow.

The leather or hides to be greased are first moistened; and having been rubbed with the greasy matter are dried in heated rooms, so that the hides, by actually combining with the fatty materials, become, as it were, tanned and tawed at the same time. In the case of hides, therefore, the greasing is not simply an operation of dressing, but in reality a second tanning (technically tawing) process.—*Wagner.*

Ebony.—Ebonizing.—Although "ebony" is a synonym for blackness, there are several colors of this wood—yellow, red, and green, as well as black. The black variety, however, is always meant when ebony is spoken of.

There are several varieties, depending chiefly upon the place of growth. That from Africa is the best, and is the only kind used for sextants. Pianoforte-keys are generally made of the East Indian variety. Ebony is often used for inlaying, in contrast with ivory; and it is also a favorite material for cabinet-work, turnery, flutes, door-handles, knife-handles, etc. It may be worked like any other hard wood, and with the same tools.

Other hard woods are often stained to imitate ebony; and when close-grained and well dyed it is sometimes difficult to distinguish them. Many samples of black ebony are not as black as is desirable, and to bring them to the required color it is necessary to dye them. A writer in *The English Mechanic* says that a good black ink is as effectual as any stain to blacken the sharps of a piano. It is, perhaps, not generally known that, though made of ebony, these keys always require staining, as true ebony is rather brown than black, and full of a yellowish grain. Old keys are probably saturated with grease: they should therefore be treated with potash first.

But while the real ebony has an indescribable richness which it is almost impossible to imitate, the demand for black wood

so far exceeds the supply that recourse is extensively had to imitation. There are two methods of so-called ebonizing in use: one is a mere black varnish, the other is a veritable dye. The varnish never proves satisfactory, as it generally has a slimy appearance, and does not show the rich dead-black grain of the wood, which is the thing to be admired. Moreover, whenever the article gets scratched or cut, the color of the original wood shows through and shows the sham at once.

The old stain for ebonizing was simply a black iron dye made by first soaking the wood in a solution of logwood and galls, and then applying a solution of acetate of iron. A much finer effect is, however, produced by the use of nigrosine,—one of the aniline dyes. It is to be purchased ready made; and the solution is found in market, and known as "ebonizing liquid."

Eelskin.—The skin of the eel, when properly prepared, is not excelled for toughness, pliability, and durability, by any other material, except perhaps the dried and well-worked pizzle of the bull, which in olden times was largely used for connecting the two parts of the threshing-flail. The eelskin should be tacked to a board, rubbed well with fat of some kind, dried, and then worked over the round edge of a board until it is perfectly supple. It may then be cut into strips of any width. As a lacing for belts, or as a material for making "catgut," it is unequalled. A mill-owner who has used eelskins largely for belt-lacing says: "Eelskins make the best possible strings for lacing belts. One lace will outlast any belt, and will stand wear and hard usage where hooks or any other fastenings fail. Our mill being on the bank of the river, we keep a net set for eels, which, when wanted, are taken out in the morning and skinned, and the skins are stuck on a smooth board. When dry we cut them in two strings,—making the eelskin, in three hours from the time the fish is taken from the water, travel in a belt.

Engravings.—*To transfer to wood.*—Fine engravings, neatly transferred to a wooden surface, form as pretty an ornamenta-

tion as can be wished, and may often be utilized in the finishing of articles made of wood. The process is as follows:—

First varnish the wood once with white hard varnish, which facilitates the transferring; then cut off the margins of the print, which should be on unsized paper, that is, paper that absorbs like blotting-paper; and wet the back of it with a sponge and water, using enough water to saturate the paper, but not so as to be watery on the printed side. Then, with a flat camel-hair brush, give it a coat of transfer (alcoholic) varnish on the printed side, and apply it immediately—varnished side downwards—on the woodwork, placing a sheet of paper on it and pressing it down with the hand till every part adheres. Then, gently rub away the back of the print with the fingers till nothing but a thin pulp remains. It may require being wetted again before all that will come (or rather ought to come) off is removed. Great care is required in this operation, that the design or printed side be not disturbed. When this is done, and quite dry, give the work a coat of white hard varnish, and it will appear as if printed on the wood.

Fahlun Brilliants.—Pieces of metal cast with plane facets in the form of crystals. They reflect the light so as to have a dark luster. The alloy of which they are made is composed of tin 29, lead 19. This alloy when melted will adhere to the polished surfaces with which it is in contact and leave them on cooling. The thickness of the deposit is regulated at will by the time of contact. It is also used for making metallic mirrors.

Fazie Metal.—An alloy said to be composed of wrought iron, cast-iron, and brass. The bronze or brass and the cast and wrought-iron are melted separately; then mixed, and continually stirred even while being poured out.

Fluxes.—"Fluxes are very frequently required in cases of chemical action amongst metallic compounds at high temperatures, and often can not be dispensed with. Their use is to protect the substance from the air; to dissolve impurities which would otherwise be infusible; and to convey active

agents, as charcoal and reducing matter, into contact with the substance operated upon."—*Faraday.*

In the large way, limestone and fluor spar are used as fluxes. On the small scale, the fluxes chiefly used are black flux, white flux, crude flux, and glass.

1. *Black Flux.*—Nitre, 1 part; crude tartar or cream of tartar, 2 parts; mix, and deflagrate, by small quantities at a time, in a crucible, heated to dull redness. The product consists of carbonate of potassa, mixed with charcoal in a finely divided state. Used for smelting metallic ores. It exercises a reducing action, as well as promotes the fusion. It must be kept in a dry corked bottle.

2. *White Flux.*—Into a large earthen crucible, heated to redness, throw successive portions of a mixture of 2 parts of nitre and 1 of tartar. Keep it as the last.

3. *Crude Flux* is the mixture of nitre and tartar before deflagration.

4. *Christison's Flux for reducing arsenic.*—Mix crystallized carbonate of soda with one eighth of charcoal, and heat gradually to redness.

5. *Fresenius's Flux for reducing sulphuret of arsenic.*—Dry carbonate of potash 3 parts, cyanide of potassium 1 part.

6. *Cornish Reducing Flux.*—Cream of tartar 10 parts, nitre 3½, borax 3. Triturate well together.

7. *Morveau's Flux.*—Pulverized glass (free from lead) 8 parts, calcined borax ½ part, charcoal ½ part. Used as black flux.

8. *Taylor's Flux.*—Saturate a solution of tartaric acid with carbonate of soda, evaporate to dryness, and calcine in a covered platinum crucible.

Furniture: its care and renovation.—Every house should have a few joiner's tools, a glue-pot, a paint-brush or two, and a box of nails, screws, and brads. With these few tools and other supplies, a handy boy or girl or housekeeper should be able to keep all the furniture in a moderate-sized house in tolerably good order if the following hints, suggestions, and instructions are followed.

The moment a piece of furniture shows signs of fracture, shakiness, or abrasion, it should be removed from actual use and repaired at once, or left unused until an opportunity arises to repair it. If it is a case of loose joints, and the spindles or tenons slip out of their mortises or holes, the old glue should be removed from both hole and tenon, if possible, and fresh hot glue applied to the work, which should be firmly held together until dry and hard, either by strings, clamps, or weights. When the work is put together and firmly secured, it should remain where placed untouched for at least twenty-four hours, so as to get dry and hard before being used. In many cases when a spindle gets loose in a chair or other piece of furniture, it is left loose until the spindle wears too small for the hole or the hole wears too large for the spindle, or both combine to make matters worse. When this is the case there is no use in using glue to make the spindle stay in place, as glue will not hold any two bodies unless the bodies fit closely together. The best way, then, to repair furniture in this state is to make a judicious use of screws, always making sure to bore holes for the screws, having the hole for the neck or straight part of the screw a trifle larger than the diameter of the screw, and the hole where the threaded or *screw* part of the screw enters a trifle smaller than the diameter of the threaded portion. The reason of this is quite obvious. Sometimes both glue and screw may be used to advantage. Nails should never be used in repairing furniture, unless by skilled workmen. Brads may sometimes be used with advantage in repairing broken carvings or in assisting glue to hold broken parts together; but even then should be used sparingly, and should never be driven without first having holes made for them by a brace and a small gimlet.

When knobs, door-handles, or drawer-pulls get loose or fall off, they should be attended to at once; and if the screws that hold them in place have worked loose and will not keep their grip, they should be taken out and new screws one or two sizes larger put in their places. This will, in most cases, re-

pair the defect. Sometimes, when knobs are used, the nut on the bolt that goes through the drawer front becomes so worn that it will not hold. When this is the case the nut may be hammered on its edge on a stone or a flat piece of iron and made so that it will hold for a time; or, if the nut has worn smooth, a piece of hard sole-leather, cut neat and round, and a small hole pierced through it, may be made to do service for a time; but these are only expedients at best, and seldom prove lasting remedies. The better way, when conditions will admit, is to cut the bolt off, just where it projects through the nut, and then rivet it solid to the drawer. Where this can not be done, the best way is to get a new knob or substitute some other kind of a pull. When drawers get rickety they should have square blocks of pine glued solid in their corners. This, when well done, prevents them from falling in pieces. Sometimes a drawer may be helped very much by having the bottom bradded in nicely. The brads help to keep the whole drawer together and rigid. If drawers do not slide easily they may be helped very materially by rubbing their sides and lower edges with dry soap. Castile is the best.

The moment a castor gets loose it should be seen to at once, or torn carpets, broken furniture, or ruined castor, will be the result. If the castor is broken or irreparably damaged, it should be removed and another one put in place: if this is not done all the other castors in the same piece of furniture should be removed until the whole set can be replaced.

When the woodwork on furniture-sets gets bruised it may be repaired by adopting the following: Wet the part bruised with warm water; double a piece of brown paper five or six times, soak the paper in the warm water and lay it on the place; apply on that a flatiron made moderately warm, and hold there until the moisture has nearly all evaporated. This will usually raise the indented part; but if it should not, simply repeat the process. Where the bruises are small, wet the part, and then hold a red-hot iron near the spot, and the bruise will soon disappear.

When the braiding or gimp on the upholstery part of furniture shows signs of wear or a tendency to get loose, it should be firmly fastened to the wood by a free use of gimp-tacks. These tacks may be obtained at any hardware store, and a paper or two should be kept in every well-directed household.

The following recipes will be found very useful in keeping furniture in good order:—

When carved work has to be polished or renovated, take half a pint of linseed-oil, half a pint of old ale, the white of an egg, one oz. spirits of wine, one oz. spirits of salts. Shake well before using. A little to be applied to the face of a soft linen pad, and lightly rubbed for a minute or two over the article to be restored, which must afterward be polished off with an old silk handkerchief. This polish will keep any length of time if well corked. The polish is useful for delicate cabinet-work; it is also recommended for papier-mache work.

For taking stains out of woodwork of various kinds, use one of the following that is most suitable:—

Ink-stains may be removed from a mahogany or cherry table by putting a few drops of spirits of salt into a teaspoonful of water, and touching the part stained with a feather dipped into the mixture. Immediately the ink-stain disappears, the place must be rubbed with a rag wet with cold water, or there will be a white mark which will not easily be removed. Ink-stains on silver or plated articles may be removed immediately and effectually without doing any injury to the things, by making a little chloride of lime into a paste with water and rubbing the stains until they disappear, and afterwards washing the article with soap and water. Ink-stains may be removed from colored table-covers by dissolving a teaspoonful of oxalic acid in a teacupful of hot water and rubbing the stained part well with the solution. Ink-stains may be taken out of anything white by simply putting a little powdered salts of lemon on the stain, damping it, allowing it to remain about five minutes, and then washing it out with soap and water, when the stain will disappear. Ink-stains may be

removed from boards by applying some strong muriatic acid or spirits of salt with a rag, and afterwards well washing the place with water.

For removing other stains, take half a pint of soft water, and put into it an ounce of oxalic acid and half an ounce of butter of antimony. Shake it well, and when dissolved it will be very useful in extracting stains as well as ink from wood, if not of too long standing.

To remove Paint or Stains from Woodwork.—Dissolve potash in water, making a strong solution. With this wash the surface of the work, allowing it to soak a few minutes. If the paint can not then be scraped off, give the wood another application, and repeat until the paint is removed. Afterward, wash the surface with clean water sufficiently to insure the removal of all the potash.

For taking off varnish from cabinet-work, use a strong application of ordinary spirits of camphor. This will remove almost any kind of polish or varnish. Give the spirits time to evaporate before repolishing, or it will injure the new polish.

The solution of potash mentioned above will also remove varnish, and must be carefully washed off before any new varnish is applied.

It sometimes happens that marble tops of tables or other furniture get so scratched that repolishing becomes necessary. The following is the process used by the mason, and will, therefore, be acceptable in a work like the present. With a piece of sandstone with a very fine grit, rub the slab backward and forward, using very fine sand and water, till the marble appears equally rough, and not in scratches. Next use a finer stone and finer sand, till its surface appears equally gone over; then, with fine emery-powder and a piece of felt or old hat wrapped round a weight, rub till all the marks left by the former process are worked out, and it appears with a comparative gloss on its surface. Afterward finish the polish with putty-powder and fine clean rags. As soon as the face appears of a good gloss, do not put any more powder on the rags, but

rub it well, and in a short time it will appear as if fresh from the mason's hands.

Another.—Make a thick paste with rotten-stone and olive-oil, and vigorously rub the marble with it on a cloth.

To polish black marble, proceed as follows: Wash it with warm soap and water, and when dry rub it well with furniture paste or French polish, and then rub it with an old silk handkerchief. After one or two trials it will become quite bright.

To remove stains on marble, apply spirits of salt and carefully wash off.

To clean Marble.—Mix the strongest soap-lees with quicklime to the consistency of milk; let it lie on the stone, etc., for twenty-four hours; then clean it off, and wash with soap and water, and it will appear as new. The polish will require to be renewed by the process given above.

Another.—Mix with a quarter pint of soap-lees half a gill of turpentine, sufficient pipeclay and bullock's gall to make the whole into a rather thick paste. Apply it to the marble with a soft brush; and after a day or two, when quite dry, rub it off with a soft rag. Apply this a second or third time till the marble is quite clean.

To clean Pictures.—Wash them with a sponge or soft leather pad and water, and dry by rubbing with a silk handkerchief. When the picture is very dirty, take it out of its frame, procure a clean towel, and making it quite wet, lay it on the face of the picture, sprinkling it from time to time with clear soft water; let it remain wet for two or three days; take the cloth off and renew it with a fresh one; after wiping the picture with a clean wet sponge, repeat the process till all the dirt is soaked out; then wash it well with a soft sponge, and let it get dry; rub it with some clear nut or linseed-oil. Spirits of wine and turpentine may be used to dissolve the hard old varnish, but they will attack the paint as well as the varnish if the further action of the spirits is not stopped at the proper time by using water freely.

There are conditions where the above simple process will

not accomplish what is required; where a thick coating of varnish has been applied to the picture, and it has been hung in a smoky room, and dust and dirt have been allowed to gather and remain; then it is that no high lights will be visible, the sky will be dirty, no distance visible, and perhaps the figures in the foreground very indistinct. Under these conditions the varnish must be either removed or the smoke and dust must be brought out of the varnish. If it is thought desirable to try the latter, the following recipe will be found valuable for the purpose: 2 oz. wood naphtha, 1 oz. spirits of salts, $\frac{1}{4}$ pint of linseed-oil.

Mix the above well together, and before using shake the bottle. It can be used as follows: Get some soft linen rag, and make up a soft pad, which place on the mouth of the bottle and shake up some of the mixture into the pad; then commence rubbing the picture with a circular motion, and when nearly dry again give the pad another dressing of mixture, and continue this mode of procedure for some time, when the picture will gradually come out in all its detail.

Paintings sometimes get convex and concave patches on their surface, owing to pressure on one side or the other, and these inequalities cause a great deal of trouble to bring out. The most successful way is to well wet both sides of the picture on the spot, and keep it under pressure till dry. With small pictures the quickest way would be to take them off the stretcher and lay them in a press, with a light pressure, between soft sheets of paper.

In cleaning mounted engravings, first cut a stale loaf of bread in half with a perfectly clean knife; pare the crust away from the edges. Now place the engravings on a perfectly flat table, and rubbing the surface with the fresh-cut bread, in circular sweeps, lightly but firmly performed, will remove all superficial markings. Now soak the prints for a short time in a dilute solution of hydrochloric acid, say 1 part acid to 100 of water, and then remove them into a vessel containing a sufficient quantity of clear chloride of lime water to cover them.

Leave them there until bleached to the desired point. Now remove, rinse well by allowing to stand an hour in a pan in which a constant stream of water is allowed to flow, and finally dry off by spreading on clean cloths. Perhaps the sheets may require ironing between two sheets of clean paper.

If the engraving is not mounted, put it on a smooth board, and cover it thinly with common salt finely powdered. Squeeze lemon-juice upon the salt, so as to dissolve a considerable portion of it; elevate one end of the board so that it may form an angle of about 45 or 50 degrees. Pour on the engraving boiling water from a teakettle until the salt and lemon-juice be all washed off. The engraving will then be perfectly clean and free from stains. It must be dried on the board or some smooth surface gradually. If dried by the fire or the sun it will be tinged with a yellow color.

When cane-bottomed chairs get loose, or lose their elasticity, they may be renovated and their elasticity restored by turning up the chair-bottoms, and with hot water and a sponge wash the cane-work well, so that it may be well soaked. Should it be dirty you must add soap. Let it dry in the air, and you will find it as tight and firm as when new, provided the cane is not broken.

For cleaning carpets, heavy draperies, or hangings, first free the fabric from dust by having it well shaken or beaten; then stretch it, either on the floor or other convenient place; then mix half a pint of bullock's gall with two gallons of soft water; scrub it well with soap and the gall-mixture; let it remain till quite dry, and it will be perfectly cleansed and look like new, as the colors will be restored to their original brightness. The brush used must not be too hard, but rather long in the hair, or it will rub up the nap and damage the article.

To destroy moths or other insects that infest carpets, pour a strong solution of alum-water on the floor to the distance of half a yard around the edges before laying the carpets. Then once or twice during the season sprinkle dry salt over the car-

pet before sweeping. Insects do not like salt, and sufficient adheres to the carpet to prevent them alighting upon it.

Another plan is to take a wet sheet or other cloth, lay it upon the carpet, and then rub a hot flatiron over it, so as to convert the water into steam, which permeates the carpet beneath, and destroys the life of the grub.

There are many recipes given for destroying the small insects that infest stuffed upholstery work, but none seems so effective as fumigation; but as this is a process that generally results in damage to the woodwork of the articles fumigated, or in destroying the colors of the fabrics, it is not to be thought of by persons who are not experts.

A free use of a camphorated solution is, perhaps, the safest remedy in these cases, though sometimes Persian powder may be used with advantage; but care should be taken in its use, particularly when there are children, or unpleasant consequences may ensue.

To polish hardwood floors in dining-rooms or halls, put some spermaceti into a saucepan on the fire, and mix it with enough turpentine to make it quite fluid; then with a piece of flannel put it very thinly on the floor. It must then be rubbed with a dry flannel and brushed in the same way that oak stairs are polished. This part of the process — rubbing and brushing — takes a long time to do thoroughly.

Another.— Dissolve half a pound of potash in three pints of water, in a saucepan on the fire. When the water boils throw in one pound of beeswax cut up in small pieces; stir it well until the wax is quite melted. When the polish is cold, if it be too thick add more water; then with a brush paint the boards evenly with it; and when it has dried rub them with a flannel tied at the end of a broom.

A paste that will be found excellent for laying cloth or leather on desks, writing-tables, or other similar work, may be made as follows:—

To a pint of the best wheaten flour add resin, very finely powdered, about two large spoonfuls; of alum, one spoonful,

in powder; mix them all well together, put them into a pan, and add by degrees soft or rain water, carefully stirring it till it is of the consistence of thinnish cream; put it into a saucepan over a clear fire, keeping it constantly stirred that it may not get lumpy. When it is of a stiff consistence, so that the spoon will stand upright in it, it is done enough. Be careful to stir it well from the bottom, for it will burn if not well attended to. Empty it out into a pan and cover it over till cold, to prevent a skin forming on the top, which would make it lumpy.

This paste is very superior for the purpose, and adhesive. To use it for cloth or baize, spread the paste evenly and smoothly on the top of the table, and lay the cloth on it, pressing and smoothing it with a flat piece of wood. Let it remain till dry; then trim the edges close to the cross-banding. If you cut it close at first, it will, in drying, shrink and look bad where it meets the banding all round. If used for leather, the leather must be first previously damped, and then the paste spread over it; then lay it on the table, and rub it smooth and level with a linen cloth, and cut the edges close to the banding with a sharp knife. Some lay their table-cover with glue instead of paste, and for cloth perhaps it is the best method; but for leather it is not proper, as glue is apt to run through. In using it for cloth, great care must be taken that the glue be not too thin, and that the cloth be well rubbed down with a thick piece of wood made hot at the fire, for the glue soon chills. By this method the edges may be cut off close to the border at once.

For "Staining," "Ebonizing," "Polishing," "Painting," "Gluing," "Gilding," "Bronzing," "Varnishing," and using "Cements," see the items given under the above headings, in the former part of this work.

Lutes.—The distinction between *lutes* and *cements* is not always very obvious. As a general rule, however, a lute is a cement used for connecting, *temporarily*, the parts of a piece

of apparatus or for coating and protecting apparatus that is to be exposed to intense heat.

Lutes for joining apparatus may be needed both for low and high temperatures; for acid or corrosive liquids or vapors, or for those which are easily resisted; and the operator must exercise good judgment in this respect if he would secure success. The lutes described in the following paragraphs afford an abundant variety for most purposes. Those who have occasion to make extensive use of lutes are recommended to read carefully the chapter on this subject in Faraday's "Chemical Manipulations," a work which may be old but can never be entirely superseded. For the joining of tubes of glass or metal, the rubber tubing, which, at the time Faraday wrote, was almost unknown, now affords a cheap, simple, and effective means,—far better than any lute,—where the temperatures are not too high. When the apparatus has to be exposed to a heat at which rubber will soften or melt, recourse must be had to one of the old-fashioned lutes. The following lutes are employed for making joints which do not require to be exposed to a high temperature:—

Glazier's Putty.— This makes a very good lute for many purposes, and is frequently used for covering the stoppers or corks of bottles containing strong acids. But owing to the fact that glazier's putty is made with carbonate of lime (whiting) it is not well adapted to this purpose. If the acids come in contact with the putty the carbonate is decomposed, and the resulting gas forces off the lute and renders it worthless.

Fat Lute.— This is similar to putty, but instead of whiting finely powdered clay is used. The lute should be well beaten and mixed, as upon this depends its excellence. The clay is not acted upon by any of the common acids, however strong, and the lute is therefore well adapted to closing joints, etc., when these liquids or their vapors are in use. Before applying this lute to a joint the glass should be wiped perfectly dry, otherwise the lute will not adhere; and if the joint is to be made very hot, the lute should be held to its place by strips of

bladder or even of linen. The oil used is the best drying linseed-oil, and the clay is pipeclay.

Strips of Bladder.— A very excellent means of joining tubes is to wind strips of bladder round the ends after they have been placed in position. The bladder should be soaked in water until soft, and if smeared with white of egg it will be the better. For all vapors except corrosive acids this makes an excellent joint.

Plaster of Paris.— This may be used occasionally for making joints tight either at common or moderately high temperatures. For the best methods of selecting, preserving, and preparing it, see the article on *Plaster of Paris.* When applied as a lute it may be made perfectly airtight by coating it with paraffine oil or wax. When it is mixed up with very thin glue instead of water it takes a longer time to solidify, but ultimately makes a much harder and stronger cement. When prepared with water alone it may be raised to a dull red heat without injury, but if mixed with organic matter (oil, wax, glue, etc.) it will not support so high a temperature unchanged.

Lime Cement.— This is made of caustic lime mixed with white of egg, glue, blood, milk, or similar matters. See *Parolic Cement.*

The lime should be freshly burned, slaked with just enough water to make it fall to powder and still be quite dry; and then it may be kept in a closely stoppered bottle. When white of egg is used, it should be beaten as is done by cooks in making cake, etc. It may then be diluted with an equal bulk of water, and the powdered lime added until the whole, when well mixed, forms a thin paste. This is spread on strips of cloth and wrapped round the joint. Faraday tells us that this lute will bear a heat approaching to visible ignition without injury.

Rubber Cement.— Dissolve 1 part of india-rubber in 2 parts of linseed-oil, by heat, and work into a stiff paste with 3 parts, or as much as sufficient, of white clay.

Water Glass Cement.— A concentrated solution of silicate of soda, made into a paste with powdered glass.

Wax Lute.— Beeswax melted and mixed with sufficient linseed-oil to render it pliable at a blood-heat.

Soft Cement.— This is made of beeswax melted with its weight of turpentine, and colored with a little Venetian red. When cold it has the hardness of common yellow soap, but at a blood-heat it is soft and easily molded. Its great use is to make tight the joints of apparatus used for preparing gases, etc., at common temperatures.

Bottle Lute.— Ordinary bottle-wax is used for closing the pores of corks and ornamenting their tops; but where it is desirable to hermetically seal a bottle containing matters which are to be kept for some time, the following preparation is to be preferred:—

Take equal parts of common resin and beeswax and enough red ochre and turpentine to bring the whole to a proper consistency. These must be melted over a fire in the following manner; and the vessel in which it is made should be capable of holding three times the quantity required, to allow ample room for boiling up. An earthenware pipkin with a handle is the best thing for the purpose, and a lid must be made of tin to fit it. The luting will be rendered more or less brittle, or elastic, as the red ochre prevails. The wax is first melted, and then the resin; the ochre is then added in small quantities, and stirred quickly with a spatula each time. When all the ochre has been added, it must be allowed to boil six or eight minutes; the turpentine is then added, and briskly stirred with the spatula, and continued boiling. There is considerable risk of the mixture taking fire. Should it do so, the lid must immediately be put on the vessel to extinguish it.

If the bottles are to be kept a very long time, a little linseed-oil added to this mixture will prevent it becoming brittle by the evaporation of the turpentine.

For making joints that are to remain tight at high temperatures, we have found nothing better than good fire-clay well

beaten to a paste with water and mixed with fine clean sand. For example, in making oxygen (which is now freely used in the arts), we use a retort consisting of a small castiron pot, with a lid rudely fitted. It is of no use to grind the lid carefully into its seat, for the process is not only too troublesome, but the joint soon becomes imperfect from the oxidation of the metal. The casting is left rough, the groove in the edge of the pot is filled with clay and sand prepared as described, and the lid is forced down so that the projection is forced into the lute. Such a joint, made with moderately stiff clay, may be placed in the fire at once, and will withstand a pressure of many pounds to the square inch. A retort of this kind is the most convenient article for all kinds of distillation and gas-making at high temperatures, as it is easily put together, easily taken apart, easily changed, and easily cleaned.

It is sometimes necessary to coat glass and metal apparatus that is to be exposed to a hot fire. This prevents the burning of the one and the melting of the other.

Coating for Glass Vessels.— 1. Dissolve one ounce of borax in a half pint of water, and add slaked lime to form a thin paste. Brush this over the retort, and let it dry gradually. Then apply a coating of slaked lime and linseed-oil beaten together. Let it dry a day or two before use, and fill up any cracks which may appear with lime and linseed-oil.

2. A lute which is said to be very efficient is made as follows: Take fragments of porcelain, pulverize and sift them well, and add an equal quantity of fine clay, previously softened with as much of a saturated solution of muriate of soda as is requisite to give the whole a proper consistence. Apply a thin and uniform coat of this composition to the glass vessels, and allow it to dry slowly before they are put on the fire.

Clay Lute.— Good fire-clay is mixed with a little sand to prevent it splitting off. A little cut tow, or horse-dung, or asbestos, is usually added to increase its coherence. It should be beaten to a stiff paste, and rolled out before application. The glass should be first rubbed over with a little of the lute

mixed with water, then placed in the center of the paste, rolled out to about a quarter or third of an inch in thickness, and the edges of the latter raised and molded to the glass, taking care to press out all the air.

Mohr's Lute.— Mix equal parts of brick-dust and litharge, and beat them into a paste with linseed-oil. Apply this with a stiff brush, and dust it over with coarse sand. Dry it in a warm place.

Notwithstanding Mohr's high reputation we have not much confidence in this lute if exposed to heat. It is no doubt serviceable at common temperatures.

Lute for Iron Retorts.—Fire-clay, 15 lbs.; carbonate of soda, 1 lb.; water sufficient to make a thick paste. Apply to the crack when at a good working heat, and cover with fine coal-dust.

Lute for Clay Retorts.— Five parts fire-clay, 2 parts white sand, 1 part of borax pressed and ground. Mix the whole together with as much water as may be necessary to bring it to the consistence of putty. Roll it in the hands to a proper length and apply it over the crack, pressing it with a long spatula into the crack.

German Paste.— This well-known food for insectivorous birds is prepared as follows: Pea-meal, 2 lbs.; sweet almonds (blanched), 1 lb.; butter or lard, ¼ lb.; moist sugar, 5 oz.; hay saffron, ½ dr. Beat to a smooth paste, adding a sufficient quantity of cold water; granulate the mass by passing it through a colander, and expose the product to the air in a warm place, until quite hard and dry. The addition of two or three eggs improves it. It will keep good for twelve months in a dry place.

Gumption, for Artists.— This is employed by the artist as a vehicle to use with some of his colors. It is composed of either poppy, nut, or linseed oil, to which a drying quality has been given by soaking in it for some days the acetate of lead, in the proportion of one ounce to the pint of oil. This being poured off clear, is mixed, according to the judgment of the

artist, with strong mastic varnish. It has much body, works easily, and dries rapidly. It may be diluted in use with spirits of turpentine.

Gut, Silkworm.— The raising of silkworms has recently become, in this country, a favorite pursuit with amateurs. The following method of utilizing these interesting insects and of producing an article that will always be in considerable demand can not fail to be of value to many of our readers.

To manufacture fine gut for angling take the best and largest silkworms you can procure, just when they are about to spin, which may be known by their refusing to eat, and having a fine silk thread hanging from their mouths. The worms must first be thrown into strong vinegar, and kept there covered close for twelve hours, if the summer be warm; or fifteen hours in cooler weather. When taken out they must be pulled asunder, and you will see two transparent guts of a greenish yellow color, as thick as a small straw, bent double, the rest of the inside resembling boiled spinach. You can make no mistake. If you find the guts soft, or break upon stretching them, you must let them lie longer in the vinegar. When fit to draw out, stretch it gently with both hands till of a proper length, or nearly so. The gut drawn out must be fastened on a thin piece of board by putting each end in a slit made at the ends of the board. It is now to be placed in the sun to dry.

It would seem that the character of the vinegar has a great influence upon the quality of the product. It must be pure and strong. That made from grape wine seems to succeed best, but further experiment is needed in this direction.

Gutta-percha.— This substance is frequently confounded by the ignorant with india-rubber, from which, however, it is entirely distinct. It is obtained by evaporating the juice of *Isonandra gutta,* a tall tree which grows only in the Malayan Archipelago. A tree, which probably numbers fifty summers, is cut down, stripped of its bark, and the juice collected in a cocoanut-shell or plantain-leaf; or else rings are cut in the

bark, about a foot apart, and the sap collected and boiled down. Gutta-percha, as imported from Malacca, contains several impurities, which consist of soluble salts, together with some organic matter, such as fragments of the bark, etc. It is purified by rasping with cold, and washing with warm water. Afterwards it is heated to 230 degrees Fah. to expel the water, which would interfere with its cohesive power; by being heated, it is also reduced to a single mass. Purified gutta-percha has a density of 0·979, and is a very bad conductor of electricity, for which reason it is so much used for insulating supports in electrical machines and coating the wire of electric cables. Gutta-percha is not acted upon either by water, hydrochloric or acetic acids, alkaline solutions, or alcohol. It is soluble in chloroform, benzol, bisulphide of carbon, rectified mineral naphtha, and rectified oil of turpentine.

There are three qualities of gutta-percha imported. The best, native, which occurs in tough flexible pieces, of a light brown or chocolate color, of all sizes and shapes. Inferior native, which is lighter in color, and more easily torn in pieces than the above. The boiled sort, which comes to Europe in oblong pieces: it probably consists of the two native sorts, boiled together to give it a fine appearance.

The solution of gutta-percha has been found very useful as an artificial cuticle in the care of cuts, burns, and extensive abrasions. Mr. Acton, however, after making various experiments with solutions of gun-cotton, caoutchouc, and gutta-percha, arrived at the conclusion that a compound solution of caoutchouc with gutta-percha possesses the requisite qualities for preserving the skin against the action of contagious poisons, and also as a covering for the hands during post-mortem examinations.

Gutta-percha has been used for belting, and as an insulator for covering wires for electrical purposes. When warmed it is perfectly plastic, and may be readily molded into any form. Indeed, it may be kneaded between the fingers into almost

any form; and consequently it has been used for various extemporized articles, such as stoppers for bottles, photographic baths, voltaic battery cells, and an infinite variety of surgical appliances. As it takes an impression of the very finest and most delicate lines and forms it has been formed into beautiful moldings, picture-frames, and other ornamental articles. When cool it is quite stiff and hard, and is quite durable.

Hands, Care of the.— Clean, soft, well-formed hands and fingers are indispensable, not only to those who would make a good appearance in society, but to those who desire to excel in fine work. The engraver, the watchmaker, and many other artists find their usefulness and power greatly impeded by anything that affects the keenness of their sense of touch and the delicacy with which they can handle minute objects. The power of a well-educated sense of touch to detect irregularities in various articles is something marvelous. The turner can, by his mere fingers, detect in a turned rod defects which are invisible to the eyes and of which the callipers give no indication. The extraordinary extent to which this sense may be educated is best seen in the blind, who train themselves to recognize various articles and even faces by means of touch. Their ability to read by simply feeling raised letters is also a wonderful example of the power of this sense when properly educated.

Like every other sense, that of touch must be carefully trained in order to make it efficient; but all the training in the world will fail to make it sensitive if the tactile surface is dulled or injured. The things which tend to dull this sense are chiefly these:—

1. Dirt. Any foreign matter which is allowed to remain on the hands combines with the perspiration and forms an incrustation which dulls the sense.

2. Handling hot articles. Some persons train themselves to handle very hot articles, and prescriptions have even been given for rendering the hands insensible to heat. In all such cases the skin is toughened and thickened, and the fine sense

of touch dulled; but so long as holders of various kinds are easily obtained, there can hardly be any reason or excuse for such a desecration of the hand. Boys are apt to try such experiments for the purpose of astonishing their friends and companions; but the loss which they sustain far outweighs any momentary gratification derived from such exhibitions.

3. Corrosive chemicals. Almost all salts and acids when brought into contact with the skin tend to make it rough and insensitive; and in the case of the hands, to disfigure and injure them. This is also true of strong, coarse soap, containing much alkali.

For keeping the hands soft there is nothing better than a little vaseline well rubbed into the hands before going to bed. The new compound known as *lanoline*, which is the carefully purified grease obtained from sheep's wool, is also said to be peculiarly efficacious.

The hands may be preserved dry for delicate work by rubbing a little club-moss pollen or lycopodium over them. This, which is an extremely fine resinous powder, is so repellant of moisture that if a small quantity of it be sprinkled on the surface of the water contained in a basin or pail, the hand, by a little adroitness, may be plunged to the bottom of the liquid without becoming wet.

Harness.—Great errors are frequently committed in the care of harness, and it often happens that from ignorance or want of thought much injury is done. This arises principally from the fact that there are two very distinct parts of all harness, and each requires, or at least will bear, very distinct treatment. Those parts which require to be pliable and soft should never be dressed with shellac varnishes or drying oils, as all such compounds tend to make the leather hard in a short time, so that it soon cracks and becomes weak. There are some parts, however, such as the saddle, blinders, etc., which are never expected to bend. Varnish does not hurt these parts, but, on the contrary, greatly improves their appearance.

All harness that is in constant use should be washed, oiled, and blacked, at frequent intervals. Some harness should be oiled three or four times a year, while carriage harness, which is used only once or twice a week, if kept in a clean harness-room or harness-closet, will need oiling only once a year, unless after exposure to drenching rain, when it should be carefully oiled and blacked as soon as it is dry enough to absorb the oil. There is danger of oiling a harness too much. When the leather appears so thoroughly saturated with oil that the oleaginous substance oozes from the pores, and absorbs dust that may be floating in the atmosphere, the leather does not need oiling. The leather should always be in such a condition, when oiled, that it will absorb the oil and leave a clean surface.

When a harness is to be oiled, take it in a clean and warm room in cold weather, or on a few clean boards out of doors in warm weather; unbuckle all the parts, and wash the surface clean with strong soapsuds. Wherever there may be a coating of gum, if soapsuds will not remove it readily, dip a coarse rag in spirits of turpentine and rub the surface rapidly. A little turpentine or benzine will remove a heavy coating of gum readily; but if applied in such quantity as to soak into the leather it will injure it. Before the oil is applied, the leather should be warmed through and through. As soon as the harness appears dry on the surface, and before the leather has become as dry as tinder to the middle, apply the oil. Traces, and some other parts of a harness which are exposed to wet and mud, are not liable to have too much oil applied to them.

Neatsfoot-oil is preferable to any other, as it will keep the leather soft. We once knew a farmer who, not understanding that linseed-oil when laid on leather would render it hard and stiff, applied a coat of it to his carriage harness, which made the leather so stiff and hard that the surface would crack badly whenever the pieces were bent.

When the oil is about to be applied, lay a piece of harness on a bench or smooth board, and use a paint-brush or swab to

lay on the oil. Let the oil be kept in a large milkpan, so that all small pieces like lines and straps may be dipped in the oil and drawn slowly through it. With the thumb and fingers slip the oil back on the straps, and let it drop into the pan. By using a large pan, one can oil a harness in a few minutes in a neat and thorough manner, without wasting any oil.

The government harness dressing is said to be prepared as follows: One gallon of neatsfoot-oil, two pounds of bayberry tallow, two pounds beeswax, two pounds of beef tallow. Put the above in a pan over a moderate fire. When thoroughly dissolved add two quarts of castor-oil; then, while on the fire, stir in one ounce of lampblack. Mix well, and strain through a fine cloth to remove sediment; let cool.

A composition which not only softens the harness but blackens it at the same time, is made as follows: Put into a glazed pipkin 2 ozs. of black resin; place it on a gentle fire; when melted, add 3 ozs. of beeswax. When this is melted, take it from the fire, add $\frac{1}{2}$ oz. of lampblack and $\frac{1}{2}$ dr. of Prussian blue in fine powder. Stir them so as to be perfectly mixed, and add sufficient spirits of turpentine to form a thin paste; let it cool. To use it, apply a thin coat with a piece of linen rag pretty evenly all over the harness; then take a soft polishing-brush and brush it over, so as to obtain a bright surface.

Icehouses.— An icehouse of some kind or another is indispensable to every country-house where ice is not delivered by the regular dealers, or where it can not be obtained when wanted.

There should be no regular floor to an icehouse,— a sand or loam floor being the best, with a layer of sawdust or planer shavings four or five inches deep, makes an excellent foundation for the ice to rest on; and it is not a bad idea to sprinkle a thin layer of sawdust between every layer of ice as it is being packed away.

The size of an icehouse will depend somewhat on the number of persons who will have to be supplied from it; but as a rule,

when the members of a family do not exceed eight, a building 10 by 14 feet, and 10 feet high at the plates, will contain quite sufficient for all household and dairy purposes. If possible, build the house on a slightly elevated spot, and have a drain made from one of its sides leading down to some layer draining a lower ground. Where convenient, lay a couple of tiers of brick or stone (the latter is to be preferred) for a sort of foundation. See that this brick or stone work is level all round, and in a fit condition to receive the ends of the studding. Cut the studding for the two sides to the proper length, and enough of them to stand about three feet apart. The studs for the ends may be left uncut, and stood up in their places. A doorway, 4 feet wide, should be left in one end, and the bottom of the door should be at least 3 feet up from the ground. A door 4 by 5 feet will be quite large enough, and it should be hung so as to swing on the outside. Nail good hemlock boards on the inside of the studding, keeping the lower edge of the first board close down to the brick or stone work. See that the joints of the ends of the boards are "broken,"—that is, have no two but-joints come on the same stud unless there is one or more boards between the joints. Board the inside walls around the four sides to the height of the side-studs, and then board the outside in the same way. When this is done, put on the roof, which may be formed of two tiers of sound boards, or it may be made of shingles and boards together, which may be of an inferior quality. Some people insist on filling in between the boarding of the walls with sawdust, tanbark, or other like materials, but this is not at all necessary, as the air confined between the walls acts as a much better protection than any of the materials named, and the filling is apt to rot the siding.

After the house has been well boarded up, strips of pine about two inches wide should be nailed up and down over the studs on the outside boarding, and common siding or weather boarding should be nailed on these strips, thus inclosing the building a third time. This operation leaves an air-space

between the siding and the boarding of about one inch, which adds greatly to the effectiveness of the building for preserving ice. This would give a thickness to the walls of about eight inches, which is made up as follows: weather boarding, one inch; air-space, one inch; hemlock boarding, one inch; air-space between boarding, four inches; inside boarding, one inch. The studs used in the building are intended in the foregoing description to be 2 by 4; but when expense is not so much of an object, 2 by 6 may be employed. Double doors—that is, a door on the outside and one on the inside—would make the house much more effective than if only one door was used. A ventilation must be made through the roof similar to a chimney: this may be ornamented to suit the taste.

If a permanent icehouse of a more expensive nature is required, then stone or brick may be employed for the outer walls, and a slate or shingle roof may be put on it; but when brick or stone is used there should be a board wall inside all round, with an air-space of three or four inches between it and the stone wall. An icehouse should never have windows in it, as the admission of light is objectionable. The floor, in the case of a stone or brick house, should be made of concrete or cement, and should be lower in the center and at one end, so as to permit the water to flow to the drain,—which, of course, would have to be provided in any case

A wooden icehouse may be made to look quite ornamental and pleasing, if properly built and nicely painted; and if cedar or chestnut is used for sills, it will last for thirty or forty years.

And now a word about packing ice. The first thing necessary is to place a layer of sawdust, spent tanbark, or straw, on the floor or ground, to a thickness of three or four inches, and on this place the ice, which will be cut in square blocks. Keep the ice as solid and compact as possible, and leave a space of about four inches between the ice and the boarding; and, as the blocks are built up solid fill this space with sawdust. Fill up all the chinks and openings between the blocks

with small pieces of ice, or pack them solid with sawdust. Everything depends on keeping the air out from between the blocks. When the house is filled, or as much is packed in as is intended, the whole should be covered with a coating of sawdust not less than two feet deep. When any of the ice is removed for use, or for other reasons, the part exposed by the removal should be carefully covered again.

Care should be taken of the sawdust, as it may be used for many years. Pine sawdust is the best.

After the house is filled and properly closed up—or, in other words, when the ice is "harvested,"—the earth should be banked up against the building all round, so as to prevent any air from getting under the sill or into the building at any point.

Lights, Night.—The convenience of having at command a small light which will burn all night and give sufficient light to enable the watcher to perform the usual offices of the sick-room has led to numerous inventions having this end in view. One of the oldest was that known as the *allnight*, which was simply a cake of wax with a slender wick in the center. This was the prototype of the modern *mortar*, which is merely a very thick dumpy candle with a very slender wick.

In providing a light to burn all night in the sick-room great care should be taken to avoid everything that can injure the air of the apartment. For this reason no volatile combustible, such as kerosene, naphtha, or any similar burning fluid should ever be used: they are sure to give off vapors which make the air offensive and dangerous. It is a common practice to use a small kerosene-lamp turned down low. Any person coming out of the fresh air into a room where such a lamp has been burning for some hours, can not fail to notice its injurious effect upon the air; and we can readily imagine what the result must be when the delicate lungs of a sick person are forced to breathe such an atmosphere.

When gas can be had it forms one of the most convenient sources of illumination; but a special burner should be used,

—one which allows very little gas to pass. If we use an ordinary burner and attempt to regulate the flame by the stopcock, much gas will be wasted, and some of it will escape into the room unburned.

One of the best devices is the old "perpetual lamp," as it was called. This consists of a small cup about three quarters of an inch in diameter and made of very thin metal, through the center of which is passed a tube about the sixteenth of an inch in diameter. The tube does not rise in the cup quite to the level of the edge, and by means of a few grains of shot it is easy to sink the cup so that the upper end of the tube will be about the level of the liquid in which the cup is made to float. This liquid is any kind of fixed oil—olive, lard, cottonseed, sperm, etc. It is easy to ignite the oil at the upper end of the tube, when it will continue to burn steadily, and will give a clear and bright but small light for a whole night.

The oil is best held in a glass tumbler, the sides of which allow the light to pass through.

We have often made these night-lamps out of half the shell of an English walnut and a common glass "bugle," such as is used by ladies for trimming some parts of their dress. In the bottom of the shell bore a hole that will just admit the bugle, and fasten the latter in place with a little sealing-wax. Then float the shell in oil, sinking it with fine shot until the oil rises to the upper end of the bugle. As the oil rises considerably by capillary attraction, the top of the bugle will be above the general level of the outside oil by an amount which will depend upon the diameter of the tube. Then hold the flame of a match or well-folded slip of paper over the top of the tube until the oil ignites, when it will continue to burn with a clear steady light until the oil is all gone. Those who prefer to use tallow or solid paraffine can easily keep these substances melted by causing the flame to heat a stout copper wire, which may be bent so as to pass down into the combustible.

Such lights are easily covered, so as to make the room quite dark, by means of an old bandbox or hatbox.

Magic Lantern Pictures.— For all the better class of pictures nothing can equal good photographs on glass; and now that amateur photographic apparatus has come into such general use, the use of the magic lantern, both for amusement and instruction, will no doubt be greatly extended. The photographs may be readily colored with aniline colors, which may be obtained of almost any shade, and which are perfectly transparent.

A simple method of forming perfectly accurate outline pictures (such as diagrams, etc.) is as follows:—

A sheet of gelatine, such as is used for tracing, is securely fixed over an engraving, and with a sharp steel point (a stout needle fixed in a wooden handle answers well) the lines of the original are traced pretty deeply on the transparent substance. Lead-pencil or crayon-dust is then lightly rubbed in with the finger, and the picture is at once ready for use. The effect of these drawings in the lantern is said to be excellent.

Illustrations for common lanterns are easily made by taking ordinary engravings on very thin paper and mounting them with Canada balsam between two plates of glass. The balsam renders the paper quite transparent, and the engraving may be colored before being mounted. The paper on which the engraving is printed must be thin, and if there should be any printing on the back of the engraving the paper must be split by the usual well-known means.

Methylated Spirit.— This liquid is frequently named in English recipes, and sometimes puzzles the American reader. Wherever methylated spirit is to be used, alcohol of 95 p. c. may be substituted for it. The term is applied in England to alcohol to which one tenth of its volume of wood naphtha (strength not less than 60 degrees o. p.) has been added, the object of such addition being that of rendering the mixture undrinkable through its offensive odor and taste. The purification of this mixed spirit, or the separation of the two alcohols, though often attempted, has always proved a failure commercially. It might be supposed that, owing to the low boiling-

point of methylic alcohol, simple distillation would effect this; but experience has shown that both spirits distil over simultaneously. This is, no doubt, due to the difference of their vapor densities.

Methylated spirit, being sold duty free, can be employed by the chemical manufacturer as a solvent in many processes for which, from its greater cost, duty-paid spirit would be commercially inapplicable. But in the preparation of medicines containing spirit as the vehicle or menstruum by which more active substances are administered, the employment of methylated spirit is highly improper. The Council of the Pharmaceutical Society obtained from the Pharmacopœia Committee of the Medical Council the decided opinion that "the substitution of 'methylated' for 'rectified' spirit in any of the processes of the Pharmacopœia should be strictly prohibited," and in Great Britain the use of methylated spirit in the preparation of tinctures, sweet spirits of nitre, common ether, or any medicine to be used internally, is now prohibited by law.

The steady refusal of our American legislators to permit the use of methylated or some similar form of alcohol in the arts, duty free, is but one illustration out of thousands of the manner in which true progress is obstructed by mere politicians.

Moire Metallique.—This method of ornamenting tin goods was at one time very fashionable; but like many other good things it has fallen somewhat into disfavor, probably owing to the "cheap" look given by inferior work. The process consists in various methods of bringing out or displaying the crystalline character of tin. This is effected by first obtaining a good crystallization, and then dissolving, by means of suitable acids, that portion of the metal which has not been crystallized and which seems to have less power of resisting acids than the crystals. The surface may afterwards be varnished or lacquered with plain or colored lacquer, and very beautiful effects produced.

The following is the original process of M. Baget:—

After cleansing away every extraneous matter, as dirt or

grease, with warm soapy water, rinse the tin in clean water. Then, after drying it, give it a heat to the temperature of bare sufferance to the hand, and expose it to the vapor of any acid that acts upon tin, or the acid itself may be poured on or laid on with a brush, the granulated crystallization varying according to the strength of the wash and the heat of your plates. Hence, it must be perceived, whatever quantity is required for any particular job of work should be made all at one time,—no two makings coming away alike, but depending entirely upon accident.

Wash 1.—Take 1 part by measure of sulphuric acid, and dilute it with five times as much water.

Wash 2.—Take of nitric acid and water equal quantities, and keep the two mixtures separate. Then, take of the first 10 parts, and 1 part of the second. Mix, and apply the same with a pencil or sponge to the surface of the heated tin, repeating the same several times, until the material acted upon loses its heat, or you may be satisfied with the appearance of your work. A transparent varnish is now to be laid on, much whereof will be absorbed, and will of course be affected by any coloring matters you may mix with it. These, however, should not be opaque colors; and a good polish being given to the work produces that enviably brilliant material we find so much in use.

Another formula which is said to give excellent results is as follows:—

The plate-iron to be tinned is dipped into a tin bath composed of 200 parts of pure tin, 3 parts of copper, and 1 part of arsenic. Thus tinned, the sheet-iron is then submitted to the seven following operations:—

1. Immersing in lye of caustic potassa, and washing.
2. Immersing in aqua regia, and washing.
3. Immersing in lye of caustic potassa, and washing.
4. Quickly passing through nitric acid, and washing.
5. Immersing in lye of caustic potassa, and washing.
6. Immersing in aqua regia, and washing.
7. Immersing in lye of caustic potassa, and washing.

Every time that the sheet-iron is placed in aqua regia the oxide of tin thereby produced must be entirely removed, since otherwise spots would form. The quickly passing through nitric acid softens the unpleasant metallic glare which, at certain angles of refraction, renders the design invisible. The copal resins deserve the preference for coating the sheet-iron after the crystallization has been thus obtained.

Nails.—It is estimated that there are over 4,000 different kinds and sizes of nails in market. Amongst the most important of these are: 1, common cut-nails; 2, finishing-nails, which are more slender and have not as large heads as common nails; 3, wrought-nails, used when it is necessary to clinch the nail; 4, clout-nails, which have broad heads and are used for nailing cloth, leather, sheet-iron, etc., to wood; 5, countersunk nails, in which the top of the head is flat; 6, billed nails, in which the head projects to one side.

The terms threepenny, sixpenny, etc., as applied to nails, arose from the fact that before cut-nails were invented all the nails in use were made by hand and sold by count. One hundred sixpenny nails were sold for sixpence (12½ cents). Afterward, when competition had reduced the price, one hundred sixpenny nails were sold for a much smaller price. As soon as the cut-nails were brought out, the price fell so materially that the nails were sold by weight, but the old designations were still retained.

It is sometimes stated that the word "penny" is merely a corruption of "pound," and that "sixpenny" nails were "six-pound" nails, or six pounds to the 1000. This is mere imagination.

Bevan determined that a wrought-iron nail, 73 to the pound and 2½ inches long, driven into dry elm to the depth of one inch across the grain, required a pull of 327 lbs. to extract it; and the same nail driven endwise or longitudinally into the same wood was extracted by a force of 257 lbs. The same nail driven two inches endwise into hard pine was drawn by a force of 257 lbs.; and to draw out one inch took 87 lbs. only.

The relative adhesion, therefore, in the same wood, when driven transversely or longitudinally, is 100 to 78, or about 4 to 3 in dry elm; and 100 to 46, or about 2 to 1, in pine; and in like circumstances, the relative adhesion to elm and pine is as 2 or 3 to 1.

The progressive depths of the same nail driven into hard pine by simple pressure were as follows:—

¼	inch,	by a	pressure of	24	pounds.
½	"	"	"	76	"
1	"	"	"	235	"
1½	"	"	"	400	"
2	"	"	"	610	"

To extract the same nail from a depth of one inch out of

Dry oak required a pull of . . .	507	pounds.
Dry beech " " " . . .	667	"
Green sycamore " " . . .	312	"

From these experiments we may infer that such a nail driven two inches into dry oak would require a force of more than half a ton to extract it by a steady pull. A common screw of one fifth of an inch in diameter was found to have an adhesive force of about three times that of a nail 2½ inches long and weighing 73 to the pound when both entered the same distance into the wood.

Haupt, in his "Military Bridges," gives a table of the holding power of wrought-iron tenpenny nails, 77 to the pound, and about 3 inches long. The nails were driven through a one-inch board into a block, and the board was then dragged in a direction perpendicular to the length of the nails. Taking a pine plank nailed to a pine block with eight nails to the square foot, the average breaking weight per nail was found to be 380 pounds. Similar experiments with oak showed the breaking weight to be 415 pounds. With 12 nails to the square foot the holding power was 542½ pounds; and with six nails in pine 463½ pounds. The highest result obtained was for 12 nails to the square foot in pine, the breaking weight being in this

case 612 pounds per nail. The average strength decreases with the increase of surface.

Tredgold gives the force in pounds required to extract threepenny brads from dry Christiana deal at right angles to the grain of the wood as 58 pounds. The force required to draw a wrought-iron sixpenny nail was 187 pounds, the length forced into the wood being one inch. The relative adhesion when driven transversely and longitudinally is in pine about 2 to 1. To extract a common sixpenny nail from a depth of one inch in dry beech, across grain, required 167 pounds; in dry Christiana deal, across grain, 187 pounds, and with grain 87 pounds. In elm the force required was 327 pounds across grain, and 257 with grain. In oak the figure given was 507 pounds across grain.

From further experiments it would appear that the holding power of spike-nails in fir is from 460 to 730 pounds per inch in length, while the adhesive power of screws two inches long, 0·22 inch in diameter at the exterior of the threads, 12 to the inch, driven into half-inch board, was 790 pounds in hard wood and about half that amount in soft wood.

The force necessary to break or tear out a half-inch iron pin, applied in the manner of a pin to a tenon in the mortice, the thickness of the board being 0·87 inch, and the distance of the center of the hole from the end of the board 1·05 inch, was 976 pounds.

As the strength of the tenon from the pin-hole may be considered as in proportion to the distance from the end, and also to the thickness, we may for this species of wood—dry oak—obtain the breaking force in pounds nearly by multiplying together one thousand times the distance of the hole from the end by the thickness of the tenon in inches.

These facts will enable us to determine approximately the number of nails required for any piece of work. The following table, which gives the denomination of the nail, its length, and the number contained in a pound, will enable us to complete the estimate:—

DENOMINATION OF NAIL, LENGTH, AND NUMBER IN A POUND.

3-penny,	1 inch,	557 nails.
4 "	1½ "	353 "
5 "	2 inches,	232 "
6 "	3 "	167 "
7 "	2¼ "	141 "
8 "	2½ "	101 "
10 "	2¾ "	68 "
12 "	3 "	54 "
20 "	3½ "	34 "
30 "	4 "	26 "
40 "	4½ "	20 "

BOAT-SPIKES.

Length.	No. to lb.
3 inches,	17·5
4 "	12·57
5 "	7·2
6 "	4·97
7 "	3·62
8 "	2·95
9 "	2·1
10 "	1·98

SHIP-SPIKES.

Length.	No. to lb.
4 inches,	8
5 "	4·37
6 "	4·2
7 "	2·75
8 "	1·74
9 "	1·55
10 "	1.15

Professor W. R. Johnson found that a plain spike ·375 inch square, driven 3⅝ inches into seasoned Jersey yellow pine or unseasoned chestnut required a force of about 2,000 lbs. to extract it; from seasoned white oak, about 4,000 lbs.; and from well-seasoned locust about 6,000 lbs.

Every one is familiar with the fact that a piece of rusty iron, wrapped in cotton or linen cloth, soon destroys the texture of the fabric. A rusting nail, for example, if laid upon a few rags, will soon produce large holes in them; or it will, at least, render every point that it touches so rotten that the cloth will readily fall to pieces at these points, and holes will be produced by the slightest hard usage. From this well-known fact we may draw the conclusion that iron, during the process of rusting, tends to destroy any vegetable fiber with which it may be in contact. This explains, to a certain extent, the rapid destruction of the wood that surrounds the nails used in outdoor work, whereby the nail is soon left in a hole much larger than itself, and all power of adhesion is lost. Part of

this effect is, no doubt, due to the action of water and air, which creep along the surface of the nail by capillary attraction, and tend to produce rottenness in the wood as well as oxidation in the iron. But when we compare an old nail-hole with a similar hole that has been exposed during an equal time, but filled with a wooden pin instead of an iron nail, we find that the wood surrounding the wooden pin has suffered least; and we may, therefore, fairly attribute a destructive action to the rusting of the iron. It might, at first sight, be supposed that, as the oxide of iron is more bulky than the pure iron, the hole would be filled more tightly and the nail held more firmly to its place. But, although this effect is produced in the first instance, yet the destruction of the woody fiber and the pulverization of the oxide soon overbalance it, and the nail becomes loose. Of course, the iron itself being also destroyed, its strength is diminished; and we have, therefore, a double incentive for preventing or diminishing the action that we have described. The only way to prevent this action is to cover the nail with some substance that will prevent oxidation. This might be done by tinning, as is common with carpet-tacks, which are now extensively tinned for the purpose of preventing them from rusting, and thus rotting holes in the carpets. Coating them with oil or tallow would be efficient, if the act of driving did not remove the protecting matter entirely from a large portion of the surface. But, even then, it will be found that the oil or fat is stripped off the point and gathered about the head in such a way as to prevent the entrance of air and moisture into the hole.

The most efficient way to coat nails with grease is to heat them to a point sufficient to cause the grease to smoke, and then pour the grease over them, stirring them about in a pot or other vessel. When the nails are hot, the melted grease will attach itself to them more firmly than it would have done if they were cold. Indeed, so firmly that it will require actual abrasion of the metal to separate it. In erecting fences, laying plank or board sidewalks and the like, it becomes an

important matter to secure the nails against the influence that we have mentioned, and yet the work must be done rapidly and cheaply. Nails may be readily prepared as described, or they may simply be dipped in oil or paint at the moment when they are driven in. And we have found, by experience, that in cases where it is not advisable to paint the whole fence, it is, nevertheless, a good plan to go over the work and touch the head of every nail with a brush dipped in oil or paint prepared so as to be of the same color as old wood.

Nine Oils.—Readers of Dickens can not fail to remember the bottle of "Nine Oils" which Sissy Jupe got for her father, and kept so long waiting for his return. This favorite old remedy has disappeared from modern pharmacopœias, and few druggists know what it is. The following is the old recipe for compounding it:—

Train-oil 1 gallon, oil of turpentine 1 quart, oil of brick and amber, each 5 ozs.; camphorated spirits of wine, 10 ozs.; Barbadoes tar, 2½ lbs.; oil of vitriol, 1 oz.

It used to be a favorite remedy with farriers, and also with workmen who were much exposed to bruises, etc.

Oil of Brick.—This ingredient is frequently named in old prescriptions and recipes. It is simply olive-oil, into which is thrown a few pieces of porous brick, made red-hot. The vessel is immediately covered over with a still or alembic head, and fire being put beneath, the oil is distilled. The product was supposed to possess very peculiar and valuable properties. It is extremely limpid, almost like water, is colorless, and does not dry up readily nor clog when drying, nor is it fat and greasy like the fixed oils. It is used in several quack medicines; and in mechanics is employed by the lapidary as a vehicle to hold the diamond-dust which he is in the habit of using.

Factitious Oil of Brick.—An article very different from that just described, but which is generally sold in the shops for oil of brick, is composed of linseed-oil, 1 lb.; spirits of turpentine, 8 ozs.; oil of hartshorn, 1 oz.; Barbadoes tar, 1 oz. Mix together with aid of heat. This is useless for any purpose in the

arts, but is sometimes employed as an embrocation in gout, rheumatism, palsy, etc.

During the days of oil-gas there was found in the vessels in which the oil was compressed for use in portable gas-lamps an oil known as "oil-gas oil." One thousand cubic feet of oil-gas yielded by compression nearly a gallon of this oil, which was used for dissolving india-rubber and for various purposes in the arts. Gray says that it is the best rubber solvent known, and that in the making of many varnishes which are required to dry quickly it is invaluable. It is entirely unknown now in the arts, but it is probable that it owed all its good properties to benzole (not the liquid commonly known as benzine).

Paint, Luminous.—The first of those *phosphori* which gave rise to what we now call luminous paint was that known as Bolognian stone. It was discovered by Vincenzio Cascariola, a shoemaker of Bologna, about the year 1630. This man having found near Monte Paterno a very heavy shining substance (sulphate of barytes or heavy spar) supposed that it must contain silver, and he consequently exposed it to heat, in the hope of extracting that metal. He failed to get any silver, but he found that whenever the mineral, after being heated and exposed to strong sunlight, was placed in a dark room, it continued to emit faint rays of light for some hours afterwards. In consequence of this interesting discovery the Bolognian spar came into considerable demand among natural philosophers and the curious in general, so that the best method of preparing it became an object of even some pecuniary importance; for, as the reader must remember, this was long before the day of lucifer matches. The family of Zagoni were the most successful in this pursuit; and in consequence furnished large quantities of Bolognian phosphorus to all parts of Europe, till the subsequent discovery of more powerful phosphori put an end to their monopoly.

The best method of preparing the mineral is first to heat it to ignition; then finely powder it, and make it into a paste with mucilage. This paste is to be divided into pieces about a

quarter of an inch thick, which are then dried in a moderate heat and afterwards carefully calcined at a red heat. Some management is requisite in conducting the calcination that it may be neither too much nor too little, by either of which faults the luminous quality is very materially injured.

At present the sulphide of calcium is preferred to any other substance,—a paint made according to the following formula giving excellent results:—

Take oyster-shells and clean them with warm water; put them into the fire for half an hour; at the end of that time take them out and let them cool. When quite cool pound them fine, and take away any gray parts, as they are of no use. Put the powder in a crucible in alternate layers with flowers of sulphur. Put on the lid and cement with sand made into a stiff paste with beer. When dry put over the fire and bake for an hour. Wait until quite cold before opening the lid. The product ought to be white. You must separate all gray parts, as they are not luminous. Make a sifter in the following manner: Take a pot, put a piece of very fine muslin very loosely across it, tie around with a string, put the powder into the top, and rake about until only the coarse powder remains. Open the pot and you will find a very small powder. Mix it into a thin paint with gum-water, as two thin applications are better than one thick one. This will give a paint that will remain luminous far into the night, provided it is exposed to the light during the day.

Luminous Enamel.—Five parts of the ordinary luminous powder prepared from oyster-shells as previously directed; ten of fluor-spar, cryolite, or other similar fluoride; one of barium borate; powdered, mixed, made into a cream with water, painted on the glass or stone article, dried, and fired in the usual way for enamels. If the article contains an oxide of iron, lead, or other metal, it must be first glazed with ground felspar, silica, lime phosphate, or clay, to keep the sulphur of the sulphide from combining with the metal. The result is an enameled luminous article.

Luminous Paper.—Take 50 parts of luminous powder, prepared as previously directed, 4 parts bichromate of potash, and 4 of gelatine. These are to be thoroughly dried, and mixed by grinding. One part of the resulting powder is stirred with 2 parts of boiling water to a thickly fluid paint, one or two coats of which are applied with a brush to the paper or pasteboard to be made luminous. To avoid inequality in the thickness of the layer of paint the paper is passed through a sort of calender with rolls at a proper distance to insure a uniform spreading of the luminous mass. The rolls may be heated, if desired.

Paint for Iron Exposed to the Weather.—The late John C. Trautwine, who was one of our most experienced engineers, tells us that the best paints for preserving iron exposed to the weather, are prepared from the pulverized oxides of iron, such as yellow and red iron ochers, or brown hematite iron ores finely ground, and simply mixed with linseed-oil and a dryer. White lead, applied directly, requires incessant renewal; and, indeed, probably exerts a corrosive effect. It may, however, be applied over the more durable colors where appearance requires it. Red lead is said to be very durable when pure. An instance is recorded of pump-rods in a well 200 feet deep, near London, England, which having first been thus painted, were in use forty-five years, and at the expiration of that time their weight was found to be precisely the same as when new, showing that rust had not affected them. When the size of the exposed iron admits of it, Faraday suggests that its freedom from rusting may be promoted to a large extent by first heating it thoroughly, and then dipping it into or washing it with linseed-oil, which will then penetrate slightly into the iron. For tinned iron exposed to the weather on roofs, rain-pipes, etc., Spanish brown is a very durable color. The tin is frequently found perfectly bright and protected where this color has been used, after an exposure of forty or fifty years. Paint containing much white lead generally washes off in a few years by the action of rain.

Where the article is exposed to mechanical action, however, the addition of red lead generally improves the paint; and in some cases, such as carriage-irons, pure red lead is decidedly the best for a first coat. It may, when dry, be painted over and concealed by any other color. To secure the best results the red lead must be selected with great care, and mixed and applied properly. Pure red lead powder, after being slightly pressed down with the finger, shows no lead crystals. When they are visible it is merely partly converted, and not first quality. It should be ground in pure old linseed-oil, and if possible used up the same day to prevent it combining with the oil before it is applied, losing in quality. No drier is necessary, as in the course of a few days the oil forms a perfectly hard combination with the lead. American linseed-oil is as good as any imported, where the manufacturer has given it age, and not subjected it to heat, as is the custom, by steaming it in a cistern to qualify it quickly for the market. It deteriorates in quality when heated above 100 deg. Fah. This red lead paint spreads very easily over a surface, and the best of finish can be made with it, even by a novice in painting.

Painters' Cream.— This is a mixture used by painters to cover their work when they are obliged to leave it for some time. It may be washed off with a sponge and water, so as to leave the painting in the exact state in which it was when work was suspended. It is composed of pale nut-oil, 6 ozs.; mastic, 1 oz.; sugar of lead, previously ground in the least possible quantity of oil, ¼ oz. Dissolve the mastic in the nut-oil, add the sugar of lead, and then add water, beating the mixture all the time until it looks like cream.

Another recipe is as follows: Take of very clear nut-oil 3 oz.; mastic in tears, pulverized, ½ oz.; sal saturni, in powder (acetate of lead, ⅓ oz. Dissolve the mastic in oil over a gentle fire, and pour the mixture into a marble mortar, over the pounded salt of lead; stir it with a wooden pestle, and add water in small quantities, till the matter assumes the appearance and consistence of cream, and refuses to admit more water.

Paintings, Repairing.— In Europe the art of repairing and revarnishing, or, as it is called, "restoring" pictures, is quite a business; and as this country grows, the business will no doubt become more general and lucrative. In its best phases the art of restoring pictures demands great skill and special taste; but there are certain cases which may be met by mere routine system. Some of the ablest scientific men have devoted their attention to the improvement of the methods in actual use; and many of their suggestions are well worthy of attention by the practical man.

Valuable paintings should be kept in a dry place, and one free from foul air. Dampness soon destroys the canvas or wood upon which the picture may be painted; and the foul emanations from stables, sinks, graveyards, etc., soon destroy the finer colors, owing to the action of the sulphuretted hydrogen and carbonic acid. Hence churches, vaults, stables, and similar places, are entirely unfit for storing paintings.

The darkening of the lights in oil paintings may be quickly changed by the application of the solution of peroxide of hydrogen,— a compound which is now found in market under the name of "Golden Bleaching Liquid." Under the action of this liquid the sulphides are at once converted into sulphates.

Paintings which have been injured may often be restored by the exercise of a little skill. In such cases the following directions will prove useful.

When by the continued pressure of some hard body the canvas presents either a concavity or convexity in a portion of its surface, it must be well wet in that part, and left gradually to dry in some cool place, keeping it constantly under pressure.

To make the colors adhere when blistered, etc.—When the color has separated from the priming, whilst the priming still remains firm, the swollen and detached part is first rubbed over with the same paste which will be presently mentioned as used for lining. Then, with a pin or needle, little holes are punctured in the part, and more paste rubbed over these holes with

a pencil, and worked about so that it shall pass through them. The surface is then wiped clean, and over the spot a pencil is passed that has been dipped into linseed-oil. This serves to soften it. A warm iron is then passed rapidly over the raised surface, which attaches itself to the priming as before. Should it be necessary to line the canvas with a new one, it should be done previously.

When a canvas is broken, rent, or perforated in any part, the piece of canvas that is used to repair the damage is dipped into melted wax, and applied the moment it is taken out, warm as it is, to the part, which has been previously brought together as well as possible, and also saturated with the wax. With great care you flatten down the piece; so that as the wax chills and concretes, the parts adhere and are kept smooth. The whole being made perfectly level, and the excess of the wax removed, a mastic made of white lead mixed with starch is applied; for oil-color does not adhere well to wax. The white is afterwards colored thin, or by washes, according to the tone of the surrounding parts, and repainted.

When the priming of a canvas has become detached, or the cloth is so old as to need sustaining, it is customary to line the picture. But if the canvas is greatly injured, the painting itself is transferred to a new subjectile. In order to render the old canvas and the color softer and more manageable, expose the picture for several days to damp. When all is ready, the first step is to fasten, by a thin flour-paste, white paper over the whole painted side of the picture, to prevent the colors scaling off. Having a new canvas duly stretched on a strong frame, a uniform coat of well-boiled paste, made of rye-flour with a clove of garlic, is spread nicely over it by means of a large brush. With dispatch, yet care, a coat of the same paste is spread likewise on the back of the picture. The latter is then laid upon the new cloth, the two pasted sides of course together. With a ball of linen the usual rubbing is given with a strong hand, beginning at the center, and passing to the edges, which must be carefully kept in place the while.

In this way the air is expelled, which remaining would cause blisters.

The picture thus lined is then placed upon a smooth table, the painted side down, and the back of the new canvas is rubbed over boldly with any suitable smoothing instrument, such as is used for linen, paper, or the like; and a warm iron is then passed over the picture, having on the other side a board to resist the pressure. The paste being heated by this iron, penetrates on the side of the picture, and fixes still more firmly the painting, while on the other side the redundant part of the paste escapes through the tissue of the new cloth, so that there remains everywhere an equal thickness. The iron must not be too hot; and before applying it several sheets of paper should be interposed between it and the paper that was at first pasted on the painting, and which would not be sufficient.

When the lined picture is sufficiently dry the paper last mentioned is damped, by passing over it a sponge moistened with tepid water. It soon detaches, and with it is removed the paste that secured it to the picture. All that remains is to clean the painting, and where needed to restore it.

The above operation will not, of course, be attempted by the amateur, except for experiment upon some picture of little worth; for even practised hands frequently injure what they were employed to preserve.

Pith for Cleaning.—Kemlo says the stalk of the common mullein affords the best pith for cleaning watch-pinions. It may be found in old fields and by-places all over the country. Winter, when the stalk is dry, is the best time to gather it. Elder-pith is good, and is easily obtained.

Plaster Casts.—The methods of making ordinary plaster casts are well known; but there are a few special methods of treating this substance which it may be well to describe. The material employed is plaster of Paris, which is obtained by exposing the purer varieties of gypsum or alabaster to a heat a little above that of boiling water, when it becomes a fine,

white dry powder. Sometimes the gypsum is first reduced to a fine powder and then heated in iron pans; and in this case the operation is sometimes called "boiling" plaster, because the escape of the water, with which crystalline gypsum is always combined, gives to the fine powder the appearance of *boiling.* Plaster of Paris, after being boiled, rapidly deteriorates when exposed to the air; consequently when plaster is required for making cements or for other purposes for which a good article is needed, care must be taken to secure that which is good and freshly boiled. The Italian image-makers always use a superior quality of plaster, and it may generally be obtained from them in small quantity.

The employment of gypsum in casting, and in all cases where impressions are required, is very extensive. A thin pulp of 1 part gypsum and 2½ parts water is made. This pulp hardens by standing. The hardening of good well-burnt gypsum is effected in one or two minutes, and more quickly in a moderate heat. Models are made in this substance for galvano-plastic purposes, for metallic castings, and for ground-works in porcelain manufacture. The object from which the cast is to be taken is first well oiled to prevent the adhesion of the gypsum.

Casts are frequently taken from living objects; and a cast of the human face is often taken for the purpose of preserving the likeness of a person. The art is easily acquired, and only demands a little care. Let the person, a mold of whose face is to be taken, lay down upon his back; let the hair be tied back, or otherwise kept back by grease, or by flour-dough placed on it; grease the eyebrows, and, if necessary, the beard and whiskers; also anoint the rest of the face with sweet oil. Then place a quill in each nostril, keeping it there with dough. Tie a towel round the face, and make it fit tight with dough also. The patient being thus prepared, mix up the required quantity of plaster of Paris with warm water, and just as it is ready to set pour it upon the face, taking care that the eyes and mouth are closed, and the outer ends of the quills above the plaster. Use a pallet-knife to spread the plaster evenly

over all parts of the face, until a coat is formed half an inch or more in thickness. In about two minutes it will set sufficiently hard to be removed. When dry and well greased, a cast in plaster may be taken from the mold, or, if wetted, a cast in wax may be taken with equal facility. A little warm water will remove the dough, etc., from the face. In this manner casts are often taken of tumors and skin diseases, the wax casts being afterwards colored. For wax casts a good composition is white wax 1 lb.; turpentine in lumps 2 ozs.; flake white 2 ozs.; and vermillion to color the whole.

There are several methods of hardening gypsum. One of the oldest consists in mixing the burnt gypsum with lime-water or a solution of gum-arabic. Another, yielding very good results, is to mix the gypsum with a solution of 20 ounces of alum in 6 pounds of water. This plaster hardens completely in 15 to 30 minutes, and is largely used under the name of marble cement. Parian cement is gypsum hardened by means of borax,—1 part borax being dissolved in 9 parts of water, and the gypsum treated with the solution. Still better results are obtained by the addition to this solution of 1 part of cream of tartar.

The hardening of gypsum with a water-glass solution is found difficult, and no better results are obtained than with ordinary gypsum. Fissot obtains artificial stone from gypsum by burning and immersions in water, first for half a minute, after which it is exposed to the air again for two to three minutes, when the block appears as a hardened stone. It would seem from this method that the augmentation in hardness is due to a new crystallization. Hardened gypsum, treated with stearic acid or with paraffine, and polished, much resembles meerschaum: the resemblance may be increased by a coloring solution of gamboge and dragon's blood, to impart a faint red-yellow tint. The cheap artificial meerschaum pipes are manufactured by this method.

Plaster of Paris treated with paraffine may be readily cut and turned in the lathe, and forms a very pleasant material to work.

When plaster is used for architectural purposes and greater hardness is required, a small quantity of lime is added. This addition gives a very marble-like appearance, and the mixture is much employed in architecture, being then known as gypsum-marble or stucco. The gypsum is generally mixed with lime-water, to which sometimes a solution of sulphate of zinc is added. After drying, the surface is rubbed down with pumice-stone, colored to represent marble, and polished with Tripoli and olive-oil. Artificial scagliola work is largely composed of gypsum.

Ordinary casts may be rendered very hard and tough by soaking them in glue size until thoroughly saturated, and allowing them to dry.

Casts of plaster of Paris may be made to imitate fine bronze by giving them two or three coats of shellac varnish, and when dry applying a coat of mastic varnish, and dusting on fine bronze-powder when the mastic varnish becomes sticky.

Rat-holes may be effectually stopped with broken glass and plaster of Paris.

Porcelain Finish.—White paint, suitable for reflectors, may be made by mixing dry white zinc carbonate with silicate of potash liquid. After each coat artificial heat should be employed to hasten the drying.

Putty.—The term *putty* is applied to three very different articles. The mason or plasterer gives this name to a finely divided and smooth paste of slaked lime, used for filling cracks, finishing off delicate parts of the work, and similar purposes. The term is also applied to the oxide of tin, so extensively used as a polishing powder by opticians, and fully described in the article on "Polishing Powders" in Part I. In general, however, when "putty" is spoken of the article known as glazier's putty is meant. It is used for setting glass in windows, for filling cracks and nail-holes, and other purposes.

The best is made of raw linseed-oil and whiting, the latter being simply chalk ground in a mill like flour. It comes out with a fine flint grit in it. Before making putty of it, a few

old-fashioned men, who believe in making the best of everything, wash the grit out. The fine flour is then dried. If it is not dried perfectly it takes up more oil than is desirable or profitable. From 500 to 600 pounds—about 15 per cent, by weight, of raw oil to 85 per cent of whiting—are put in a chaser and thoroughly mixed. The chaser is an annular trough, ten feet in diameter. From a vertical shaft in the center two arms extend, on the ends of which are heavy iron wheels that rest in the trough. When the shaft revolves the wheels chase each other around the trough. When mixed, it is packed in bladders for convenience in handling.

The adulteration of putty is effected by mixing marble-dust with whiting. It costs about a quarter of a cent a pound, and whiting costs twice that. Paraffine oils, at from 20 to 30 cents a gallon, are used instead of linseed-oil at 60 cents. The marble-dust makes the putty gritty, and the cheap oil makes it sticky.

A superior article of putty is made, however, by the further addition of white lead in oil, Japan varnish, and a small quantity of turpentine, which makes a hard cement that does not shrink, and when dry can be rubbed down with pumice-stone or dusted with sandpaper, so smoothly will it cut. Even in the common sorts of putty it is well to use some white lead if a hard putty is desired. Colored putty has a mixture of red ocher, lampblack, or other color, with the whiting.

For stopping large cracks, especially when leaks are to be stopped, the compound known as "aquarium cement," and described in Part I, is altogether the best material that can be used. For puttying up the cracks in beehives it has no equal, as it does not contract and fall out, and it is so hard that no vermin can penetrate a crack that has been filled with it.

Hard Putty.—Take the whiting, mash all the lumps out on the stone, and mix it into a stiff paste by adding equal parts of Japan and rubbing varnish; then add as much keg-lead as you think will make it work free with the knife; then add the rest of the whiting until you have it to suit you. This will

sandpaper good with one day's drying. If you want putty that will dry quicker, take dry white lead and mix with equal parts of Japan and varnish, to which add a few drops of turpentine. This is very soft for puttying, but can be sandpapered in from two to three hours, it becoming perfectly hard in that time.

Soft Putty.— Take 10 lbs. of whiting and 1 lb. of white lead; mix with the necessary quantity of boiled linseed-oil, and add to it ½ a gill of the best salad-oil. The last prevents the white lead from hardening, and preserves the putty in a state sufficiently soft to adhere at all times, and not, by getting hard and cracking off, suffering the wet to enter, as is often the case with ordinary hard putty.

To Soften Putty.—1 lb. of pearlash, 3 lbs. of quick stone lime; slake the lime in water, then add the pearlash, and make the whole about the consistence of paint. Apply it to both sides of the glass and let it remain for twelve hours, when the putty will be so softened that the glass may be taken out of the frame with the greatest facility.

Water-glass Putty.— This is made with water-glass (silicate of soda) and zinc-white, and is highly recommended as a putty for iron.

Rangoon Oil.— This material is frequently alluded to in industrial works and journals published in Great Britain. It is simply petroleum obtained from Rangoon, in Burmah. The crude product is known as *Rangoon tar;* the purified oil as *Rangoon oil.* Where Rangoon oil is prescribed, a good quality of kerosene may, in almost every case, be used in its stead.

Razor-strops.— The following article, which we extract from "Trade Secrets," contains the pith of the accessible information on this subject:—

A good razor-strop is indispensable, not only to the barber and to those who shave themselves, but to all who require exceedingly sharp cutting tools. The surgeon, the wood-carver, the microscopist, and many other artists, are greatly aided in their work by the use of a good strop.

The basis of the best strop is good hard leather. By *hard*

leather we do not mean leather that has been rendered stiff and hard by alternate wetting and drying, but leather that is so close and firm in texture as to be compressed with difficulty. Leather that is soft yields to the pressure of the edge of the tool, and rises up when this edge passes over it. Instead of a sharp edge, formed by two *planes* meeting each other, a blunt edge, formed by the meeting of two curved surfaces, is the result, and such an edge can never cut cleanly and well. This arises partly from the defective form, and also from the great increase in the cutting angle of the edge.

Good hard calfskin probably makes the best surface for a strop. Excellent pieces may in general be obtained from the bookbinders for a trifle, and they are easily attached to the wooden holder by means of a little glue. Two surfaces are generally employed: one in its natural condition, and the other after being rubbed with some very hard but fine powder. Of the powders that have been suggested the following give good results:—

1. Colcothar, or crocus, well burned and very finely pulverized. The crocus used for plate-polishing is too soft; but, by heating, it becomes so hard that it polishes steel quite rapidly.

2. Emery, brought to a state of the very finest powder by grinding and washing.

3. The charcoal of wheat-straw, or the straw of grasses growing in swamps or marshy places. This charcoal owes its efficacy to the small quantity of silica which it contains.

4. Diatomaceous earth. Of this the famous Tripoli powder is a good example. Such earth is found quite extensively in this country. In its natural state the particles are too coarse, and the earth is apt to be gritty from the presence of fine sand. It should be well ground in a mortar and carefully washed.

5. The fine carbonaceous dust deposited in gas-retorts during the process of making gas. The particles of this black dust are as hard as diamonds, and cut steel rapidly: they are, in fact, very minute diamonds. All these powders ought to be

carefully washed, or rather "elutriated," so as to separate the coarser particles and the impalpable dust, which does no good, but, on the contrary, clogs the cutting action of the material. After being carefully washed the powder is dried, and either mixed with a little tallow and wax, or the leather is first rubbed very lightly with the greasy mixture, and then very lightly coated with the powder. When made into cakes with grease the material is known as "razor-paste," and is sold as such. Crocus, in the form of cakes and sticks, can also be found in most tool-stores.

Diamond-dust, or the powder produced by rubbing diamonds against each other in the process of cutting and polishing them, possesses very powerful cutting qualities; and when properly used on suitable "laps" or metal blocks, it enables us to give a very keen edge to every species of cutlery. Cooley tells us that "the discovery, or assumed discovery, of this fact, a few years since, led certain knaves to extensively advertise and puff a spurious preparation (powdered quartz) under the name of diamond-dust. In a short time the demand for the fictitious article became immense. It soon, however, acquired a bad notoriety. Instead of sharpening cutting instruments it infallibly destroyed their edge, and was particularly unfortunate in converting razors into saws. This discovery was not made until it was in the hands of the majority of the adults in the kingdom; nor before the scamps who had manufactured and vended it had realized a moderate fortune."

It is very evident, however, that the evil effects in this case arose from wrong methods of manufacture and preparation. Quartz crystals, which have been frequently sold as 'diamonds,' under the names of "California diamonds," "Alaska diamonds," etc., were ground as finely as ordinary stamping-mills would grind them: the powder was bolted or sifted, and in this state placed on the market. Now, it is the last degree of pulverization that costs in this case. It is easy to reduce the quartz to coarse powder, and not very difficult to obtain a tolerably fine powder; but to get a quartz powder sufficiently fine and free

from coarse particles to serve as a polisher or sharpener for cutlery is a more difficult matter. From experiments we have made it would seem that pulverized quartz might be a very valuable grinding and polishing material; and as it can be had in almost unlimited quantities for nothing, it offers a fine field for enterprise. When thoroughly ground it should be first sifted or bolted, and then washed or elutriated, so as to separate all grit.

Smoke-stains.— To remove smoky stains from walls brush them with a broom; then wash them over with strong pearlash water, and immediately rinse them with clean water before the pearlash is dry. When dry, give the walls a thin coat of freshly slaked lime, containing a liberal proportion of alum dissolved in hot water. Finish with whiting and good size. Be careful not to apply the size distemper until the lime-wash is dry, as the latter will destroy the strength of the size if the two come in contact while wet.

Spence's Metal.—Great hopes were at one time entertained in regard to this mixture; but of late it seems to have lost favor. It is, however, a really valuable preparation for some purposes. It is prepared by melting together the three sulphides of iron, zinc, and lead, with sulphur. The resulting dark gray mass possesses great tenacity, small power of conducting heat, a specific gravity of 3·4, and a melting point of about 320 deg. Fah. In congealing it expands like type-metal, so that it fills every crevice of the mold and gives a most accurate impression. If, when melted, it is poured on a plate on which the impression of the hand has been made, the casting will show all the lines and markings of the palm.

It possesses in a remarkable degree the power of resisting atmospheric and corrosive influences. Alkalies, acids, and even aqua regia have little or no effect on it except at a comparatively high temperature. Its surface was scarcely corroded after being exposed to the action of aqua regia for four weeks. As a cement for joining pipes it is invaluable; and it has been extensively used in England for gas and water pipes.

Sponges.— The sponge is one of the most useful articles in the household and in the arts, and it is well to know both how to choose it and how to care for it. The best sponges come from the Mediterranean, and are found compressed and dried, so that when soaked and fully expanded they increase to several times the bulk which they have in the compressed state. In selecting a sponge see that it is not loaded with sand and limy matter. To cleanse sponges from these impurities they are beaten, washed in water, and sometimes soaked in acid. It is said, however, that the use of mineral acids destroys the fiber of the sponge, and this is very probably the case. It is possible that dilute acetic acid might be used without any bad effects; and the cheap acid obtained from wood by destructive distillation would answer every purpose.

Second-hand sponges are frequently offered for sale. These are picked up in various places, washed, soaked in solution of chloride of lime or soda, again washed in clean water, and dried. Such sponges do not last long: they are frequently half rotten before they reach the bleacher's hands; and if he does not do his work thoroughly they may even convey infectious matter. But being cheap and pretty they meet with a ready sale.

For all ordinary purposes the dark color of the sponge is no objection; but when a white sponge is desired the following method of bleaching has been highly recommended:—

Having made the sponges free from sand and calcareous matter by gently beating them, wash them in water, squeeze them as dry as possible, and then place a few at a time in a solution of permanganate of potassa, made by dissolving one hundred and eighty grains of the salt in five pints of water, and *pouring a portion* of the solution into a clean glazed vessel. Let them remain a few moments until they have acquired a dark mahogany-brown color, when they are to be squeezed by hand to free them from the solution. They are then dropped a few at a time into a bleaching solution made as follows: Hyposulphite of soda, ten ounces; water, sixty-eight fluid

ounces; when dissolved, add five fluid ounces of muriatic acid. This solution should be made the day before being wanted for use, in order that the sulphur precipitated by the acid may be easily separated. This solution is poured off from the sulphur, and, if necessary, is strained through muslin into a glazed vessel. The sponges are allowed to remain in this solution a few moments, squeezing them with the hand occasionally in order that every part may be reached by the fluid; then squeeze out and wash through several waters to rid them of the sulphurous odors. They may be completely deodorized by washing them in a weak alkaline solution of bicarbonate of soda, about one hundred grains to the pint, and then washing through several waters to free from any traces of the alkali. Much caution must be used in this last operation lest the bleaching effect of the previous solutions be partly neutralized. When the sponges are *nearly dry* immerse them into a solution of glycerine water, one half ounce to the pint, squeeze them as dry as possible, and dry them in the shade. Be sure and not let direct sunlight on them until dry. They will be as soft and white as wool.

Sulphur Casts.— Sulphur is a favorite material with which to make casts of coins and similar articles. The process is as follows:—

Prepare the coin or other body of which the mold is to be made, by slightly oiling the surface; or if the body be made of plaster of Paris, the back of it is to touch the surface of water in a saucer or other convenient vessel, until the water just appears upon the surface, which will be known by its becoming more glossy. Then, having a sufficiently long strip of thick paper, from half an inch to an inch and a half in width, fold this round the coin; hold the paper between the thumb and fingers of the left hand, or if the medal should be large, or if a number are to be done at once, fasten the end of the paper with paste. Then melt by a very slow and gentle heat a little roll brimstone. When in a melted state, and while quite liquid, pour it steadily upon the coin. In a few minutes it will

become crystallized into a semitransparent mass, which may be removed from the coin or plaster cast, and will be found to be a fine and very exact counterpart of the original; and having plaster of Paris afterward poured into it, it will yield a very perfect impression.

Imitation coins may be made of sulphur by the following method:—

Prepare first the requisite molds of both sides of the coin by pouring plaster of Paris on each side alternately. Make a line, or other mark, on each mold, to show the position that they are afterward to be placed in, that the heads and devices may be in such a position relative to each other as they are in the original coin. Then melt the sulphur;—that is best which has been melted two or three times before, so that it has acquired a light brown color. When ready to pour, hold the two molds at the proper distance from each other, according to the thickness of the coin, and with the marks of both in line with each other, and wind round the edge of the molds a strip of card in such a manner that the card shall go very nearly round them,—a small vacuity only being left at the top. This being prepared, hold the card between the fingers and thumb, then pour in the sulphur, and as it shrinks, pour in more, until the space between the molds is full. It will immediately congeal, and when removed it will be found to have taken a fine impression from the molds, and to have all the sharpness of the original coin. When taken out it may be trimmed with a knife around the edges, for sulphur has the property of remaining soft for some considerable time after melting. To give the artificial coins clearness, and an appearance of antiquity, they must be rubbed all over with black lead, and then the black lead removed from the more prominent parts with a soft damp rag. A fine metallic appearance is given to medals by varnishing over the black lead surface with a weak solution of dragon's blood in spirits of wine, instead of partially rubbing the black lead off. The molds must of course be damped previously to using.

Thatched Roofs.—Good straw makes a most excellent covering for buildings in the country; and as timber is becoming more valuable and slate can only be obtained from considerable distances, it is probable that straw will be used more and more in the future. Thatch makes a warm and durable roof; and owing to its porosity it tends to keep the air in stables and outhouses pure and clear, since the law governing the "Diffusion of the Gases" has full play.

The great objection to thatch is the danger from fire; but it may be rendered comparatively incombustible by soaking it in whitewash made of lime, or whiting and size, in the usual way, to every four gallons of which has been added one pound or rather more of alum. Alum would suffice by itself; but the rain would wash it off. The lime and size form a film over every straw, insoluble in water. If the interior of a thatched roof be kept dry, it will last as long as the timber which supports it.

As regards the durability of thatch under ordinary conditions, Loudon makes the following statement:—

"We have known many roofs of this kind in Scotland which have lasted the length of a farmer's lease (nineteen or twenty-one years) without any repairs; the surface of the thatch becoming covered with growing moss excludes air and moisture, and prevents decomposition."

Thatching is an art which requires a good deal of skill and experience; and the difference between a well-made roof and one that has been put together by an unskillful hand is very great, both as regards efficiency and durability. In many parts of Europe thatching is a regular trade, to which the beginner serves an apprenticeship, as to any of the ordinary trades. The following directions, however, if carefully followed, will enable the amateur to cover a small building in a manner that is at least respectable:—

Rye or wheat straw only should be used, and must be carefully threshed with a flail to leave the straws unbroken. Bind in bundles, distributing the buts of the straws equally to each

end of the bundle. A good roof can not be made if the straws all lie one way. It was always customary to make the band three feet long, as this gave a bundle of convenient size for handling. In a dry time we sat the bundles on end and threw water upon them a day or two before we used them.

The rafters are placed in the usual way, and crossed by slats two by two, nailed 14 inches apart, though 12 inches will do equally well.

Begin at the eaves and lay a row of bundles across. Have an iron needle 18 inches long prepared and threaded with oakum 8 feet long. Fasten the thread to the slat and pass the needle through the bundle to a boy stationed under the rafters, making three to four stitches to the bundle. The boy draws the cord up tight, and passes the needle up through again, but on the other side of the slat. By this means the first course is sewed on. Succeeding courses are treated in the same way, being laid so as to overlap the stitching. Lay the heaviest row of straw at the eaves to make it look well. When you come to the ridge, fold the tops of the straw over until you bring up the other side, then get some thin sods, 10 by 14 inches, and 1½ inches thick, and lay them neatly upon the top, using a small piece of board to clap them all slick and smooth. Boards put on like ordinary ridge-boards will do instead of sods, if preferred.

Get the point of an old scythe, about 18 inches long; attach a handle, so that it will be like a long knife, and with it "switch down" the roof all over, to carry off all the loose straws, and trim the others off smooth. If well done, the roof will be as smooth as a board. Stretch a cord along the eaves the whole length of the building, and trim off straight by it, leaving the outside a little lower than the inside, which will prevent its looking thick and heavy.

A roof made in this way will not be injured by wind and rain, and it ought to last from 25 to 30 years in the Middle States.

Tiers-Argent.—This alloy is so called because it is supposed to consist of one third silver. According to the analyses of Dr. Winkler its composition is: copper, 59·06; silver, 27·56; zinc, 9·57; nickel, 3·42. This alloy is used instead of pure silver in the manufacture of spoons, forks, and other forms of plate, for which purpose it is extremely well adapted, as it is harder than the ordinary alloy of silver, and its color and polish are as good. It would form an admirable material for the cases of the cheap but serviceable watches that are now coming into such general use.

Veneering.—The softest woods should be chosen for veneering upon,—such as common cedar or yellow pine. Perhaps the best of all for the purpose is "arrow board," twelve foot lengths of which can be had of perfectly straight grain, and without a knot. Of course no one ever veneers over a knot. Hard wood can be veneered,—boxwood with ivory, for instance; but wood that will warp and twist, such as nasty cross-grained mahogany, must be avoided.

The veneer, and the wood on which it is to be laid, must both be carefully prepared, the former by taking out all marks of the saw on both sides with a fine toothing plane, the latter with a coarser toothing plane. If the veneer happens to be broken in doing this, it may be repaired at once with a bit of stiff paper glued upon it on the upper side. The veneer should be cut rather larger than the surface to be covered; if much twisted it may be damped and placed under a board and weight over night. This saves much trouble; but veneers are so cheap—about two cents a foot—that it is not worth while taking much trouble about refractory pieces. The wood to be veneered must now be sized with thin glue: the ordinary glue-pot will supply this by dipping the brush first into the glue, then into the boiling water in the outer vessel. This size must be allowed to dry before the veneer is laid.

We will suppose now that the veneering process is about to commence. The glue in good condition, and boiling hot, the bench cleared, a basin of hot water with the veneering hammer

and a sponge in it, a cloth or two, and everything in such position that one will not interfere with or be in the way of another.

First, damp with hot water that side of the veneer which is not to be glued, then glue the other side. Second, glue over as quickly as possible the wood itself, previously toothed and sized. Third, bring the veneer rapidly to it, pressing it down with the outspread hands, taking care that the edges of the veneer overlay a little all round. Fourth, grasp the veneering hammer close to the pane (shaking off the hot water from it) and the handle pointing away from you; wriggle it about, pressing down tightly, and squeezing the glue from the center out at the edges. If it is a large piece of stuff which is to be veneered, the assistance of a hot flatiron from the kitchen will be wanted to make the glue liquid again after it has set; but don't let it dry the wood underneath it, or it will burn the wood and scorch the veneer, and ruin the work. Fifth, having got out all the glue possible, search the surface for blisters, which will at once be betrayed by the sound they give when tapped with the handle of the hammer; the hot iron (or the inner vessel of the glue-pot itself, which often answers the purpose) must be applied, and the process with the hammer repeated.

When the hammer is not in the hand it should be in the hot water.

The whole may now be sponged over with hot water, and wiped as dry as can be. And observe throughout the above process never have any slop and wet about the work that you can avoid. Whenever you use the sponge, squeeze it well first. Damp and heat is wanted, not wet and heat. It is a good thing to have the sponge in the left hand nearly all the time, ready to take up any moisture or squeezed-out glue from the front of the hammer.

So much for laying veneers with the hammer, which, though a valuable tool for the amateur, is not much used in the best cabinet-makers' shops. Cauls are adopted instead. They are

made of wood, the shape and size of the surface to be veneered; or, better still, of rolled zinc plate, and being made very hot before a good blaze of shavings, they are clamped down on the work when the veneer is got into its place. They must be previously soaped to prevent them sticking to the veneer. The whole is then left to dry together.

The hammer is quite sufficient for most amateurs. I have laid veneers with it five feet long by eighteen inches wide without assistance, and without leaving a blister. Cauls, however, are very necessary if a double curved surface has to be veneered, or a concave surface: they need not be used for a simple convex surface. By wetting well one side of the veneer it will curl up, and can easily be laid on such a surface; but it will be well to bind the whole round with some soft string to assist in keeping it down while drying.

Waterproofing.—A few years ago a patent was taken out by Dr. Stenhouse for employing paraffin as a means of rendering leather waterproof, as well as the various textile and felted fabrics; and since then additional patents have been granted for an extension of and improvement on the previous one, which consisted chiefly in combining the paraffin with various proportions of drying oil, it having been found that paraffin alone, especially when applied to fabrics, became to a considerable extent detached from the fiber of the cloth after a short time, owing to its great tendency to crystallize. The presence, however, of even a small quantity of drying oil causes the paraffin to adhere much more firmly to the texture of the cloth, from the oil gradually becoming converted into a tenacious resin by absorption of oxygen.

In the application of paraffin for waterproofing purposes, it is first melted together with the requisite quantity of drying oil, and cast into blocks. The composition can then be applied to fabrics by rubbing them over with a block of it, either cold or gently warmed, or the mixture may be melted and laid on with a brush, the complete impregnation being effected by subsequently passing it between hot rollers. When this

paraffin mixture has been applied to cloth such as that employed for blinds or tents it renders it very repellant to water, although still pervious to air.

Cloth paraffined in this manner forms an excellent basis for such articles as capes, tarpaulins, etc., which require to be rendered quite impervious by subsequently coating them with drying oil,—the paraffin in a great measure preventing the well-known injurious influence of drying oil on the fiber of the cloth. The paraffin mixture can also be very advantageously applied to the various kinds of leather. One of the most convenient ways of effecting this is to coat the skins or manufactured articles—such as boots, shoes, harness, pump-buckets, etc.—with the melted composition, and then to gently heat the articles until it is entirely absorbed. When leather is impregnated with the mixture it is not only rendered perfectly waterproof, but also stronger and more durable. The beneficial effects of this process are peculiarly observable in the case of boots and shoes, which it renders very firm without destroying their elasticity. It therefore not only makes them exceedingly durable, but possesses an advantage over ordinary dubbing in not interfering with the polish of these articles, which, on the whole, it rather improves. The superiority of paraffin over most other materials for some kinds of waterproofing consists in its comparative cheapness, in being easily applied, and in not materially altering the color of fabrics, which in the case of light shades and white cloth is of very considerable importance.

Water-tight Walls.—The interior walls of the gate-houses of the Croton Reservoir in Central Park, New York, have been successfully treated according to the Sylvester process, which is fully described in a paper read by Mr. Dearborn before the American Society of Civil Engineers, May 4, 1870.

The process consists in using two washes or solutions. The first, composed of three quarters of a pound of castile soap dissolved in one gallon of water, laid on at a boiling heat with a flat brush. When this has dried, twenty-four hours later

apply in like manner the second wash of half a pound of alum dissolved in four gallons of water. The temperature of this when applied should be 60 to 70 deg. Fah. After twenty-four hours apply another soap wash, and so on alternately until four coats of each have been put on. Experiments showed that this was sufficient to make the wall water-tight under forty feet head of water.

At the time of application the walls had been saturated, and the weather was cold. The gate-chambers were covered over and heated thoroughly with large stoves. The drying, cleaning the walls with wire brushes, and applying the mixture, took ninety-six days. Twenty-seven tons of coal were used for the drying, and one ton for heating the soap solution. Eighteen thousand eight hundred and thirty square feet of wall were washed with four coats. The drying and cleaning of the walls cost 6½ cents per square foot; and the plant, materials, and labor of applying the wash cost 3⅝ cents per square foot.

Wax-milk.—This is a partly saponified emulsion of wax, which has been sold extensively as a furniture polish. It may be prepared from ordinary beeswax, but the cheaper Japanese wax answers quite as well. Boil one part of yellow soap and three parts Japanese wax in twenty-one parts of water, until the soap dissolves. When cold it has the consistency of salve, and will keep in closed vessels as long as desired. It can be used for polishing carved woodwork and for waxing ballroom floors, as it is cheaper than the solution of wax in turpentine, and does not stick or smell so disagreeably as the latter.

White Metal.—This term has been applied to a large number of alloys of very varying composition. (See *Copper, Blanched; Albata; Tutania*, and others.) An alloy which is very generally known in the arts as "white metal" is composed of antimony, 32; tin, 10; brass, 8. Another "white metal" is composed of lead, 10; bismuth, 5; antimony, 4.

Wood.—Probably the oldest timber in the world which has been subjected to the use of man is that which is found in the

ancient temples of Egypt. It is found in connection with stone-work which is known to be at least 4,000 years old. This wood, and the only wood used in the construction of the temple, is in the form of ties, holding the end of one stone to another in its upper surface. When two blocks were laid in place, then it appears that an excavation about an inch deep was made in each block, into which an hour-glass shaped tie was driven. It is therefore very difficult to force any stone from its position. The ties appear to have been the tamarisk, or chittim-wood, of which the ark was constructed, a sacred tree in ancient Egypt, and now very rarely found in the valley of the Nile. Those dovetailed ties are just as sound now as on the day of their insertion. Although fuel is extremely scarce in that country, those bits of wood are not large enough to make it an object with Arabs to heave off layer after layer of heavy stone for so small a prize. Had they been of bronze, half the old temples would have been destroyed ages ago, so precious would they have been for various purposes.

Rankine says there are certain appearances characteristic of good wood, to what class soever it belongs. In the same species of wood that specimen will in general be the strongest and most durable which has grown the slowest, as shown by the narrowness of the annular rings. The cellular tissue, as seen in the medullary rays (when visible), should be hard and compact. The vascular or fibrous tissue should adhere firmly together, and should show no wooliness at a freshly cut surface, nor should it clog the teeth of the saw with loose fibers. If the wood is colored, darkness of color is in general a sign of strength and durability. The freshly cut surface of the wood should be firm and shining, and should have somewhat of a translucent appearance. In wood of a given species the heavy specimens are in general the stronger and more lasting. Among the resinous woods, those having the least resin in their pores, and among non-resinous woods those which have least sap or gum in them, are in general the strongest and

most lasting. Timber should be free from such blemishes as "clefts," or cracks radiating from the center; "cup-shakes," or cracks which partially separate one layer from another; "upsets," when the fibers have been crippled by compression; "windgalls," or wounds in a layer of wood, which have been covered and concealed by the growth of subsequent layers over them; and hollow or spongy places in the center or elsewhere, indicating the commencement of decay.

The finest and most costly of the veneer-woods is French walnut,—a wood that does not come from France, but from Persia and Asia Minor. The tree is crooked and dwarfed, and is solely valuable for the burls that can be obtained from it. These are large tough excrescences, growing upon the trunk. In this the grain is twisted into the most singular and complicated figures. The intricacy of these figures, combined with their symmetry, is one of the elements that determine the value of the burl. Color and soundness are other elements of value, which varies very widely. Burls worth from $500 to $1000 each are not rare; and at the Paris Exposition of 1878 one burl weighing 2,200 pounds was sold for $5,000, or upwards of $2 a pound.

Polishing with Charcoal.—The following method of polishing wood with charcoal is now much used by French cabinet-makers, and produces that well-known beautiful dead black color, with sharp clear edges and a smooth surface, which give the wood the appearance of ebony. When articles of furniture finished in this way are viewed side by side with furniture rendered black by paint and varnish, the difference is so sensible that the considerable margin of price between the two kinds explains itself without need of any commentary. The operations are much longer and much more minute in charcoal polishing, which respects every detail of the carving, while paint and varnish would clog up the holes and widen the ridges. Only carefully selected woods, of a close and compact grain, are employed. These are covered with a coat of extract of logwood and nutgalls dissolved in water; and almost

immediately afterward with another coat composed chiefly of sulphate of iron, or green vitriol, dissolved in water. The two compositions in blending penetrate the wood and give it an indelible tinge, and at the same time render it impervious to the attacks of insects.

When these two coats are sufficiently dry the surface of the wood is first rubbed with a very hard brush of scouring grass, and then with charcoal of substances as light and friable as possible, because if a single hard grain remained in the charcoal this alone would scratch the surface, which should be rendered perfectly smooth. The flat parts are rubbed with natural stick charcoal, the indented portions and crevices with charcoal powder. At once, almost simultaneously, and alternately with the charcoal, the workman also rubs the piece of furniture with flannel soaked in linseed-oil and the essence of turpentine. These pouncings, repeated several times, cause the charcoal powder and the oil to penetrate into the wood, giving the article of furniture a beautiful color and perfect polish, which has none of the flaws of ordinary varnish. Black wood, polished with charcoal, is coming day by day to be in greater demand. It is most serviceable; it does not tarnish like gilding, nor grow yellow like white wood; and in furnishing a drawing-room it agrees very happily with gilt bronzes and rich stuffs. In the dining-room, too, it is thoroughly in its place to show off the plate to the greatest advantage; and in the library it supplies a capital framework for handsomely bound books.

Stains for Wood.— Leo, of Bensheim, Germany, recommends the following stains for oak, pine, beech, poplar, etc.

1. *Yellow Stain.*— Wash over with a hot, concentrated solution of picric acid, and when dry, polish the wood.

2. *Ebony Black.*— Wash with a concentrated aqueous solution of extract of logwood several times. Then with a solution of acetate of iron of 14 deg. Baumé, which is repeated until a deep black is produced.

3. *Gray.*— One part of nitrate of silver dissolved in 50 parts

of distilled water. Wash over twice; then with hydrochloric acid, and afterwards with water of ammonia. The wood is allowed to dry in the dark, and is then finished in oil and polished.

4. *Light Walnut.*—Dissolve one part of permanganate of potassium in 30 parts of pure water, and apply twice in succession; and after an interval of five minutes wash with clean water, and when dry oil and polish.

5. *Dark Walnut.*—Same as for light walnut; but after the washing with water, the darker veins are made more prominent with a solution of acetate of iron.

6. *Dark Mahogany.*—Introduce into a bottle 15 grains alkanet root, 30 grains aloes, 30 grains powdered dragon's blood, and 500 grains 95 per cent alcohol, closing the mouth of the bottle with a piece of bladder, keeping it in a warm place for three or four days, with occasional shaking; then filtering the liquid. The wood is first mordanted with nitric acid; and when dry washed with the stain once or oftener, according to the desired shade; then the wood being dried, oiled, and polished.

7. *Light Mahogany.*—Same as dark mahogany, but the stain being only applied once. The veins of true mahogany may be imitated by the use of acetate of iron skillfully applied.

A favorite recipe for staining wood a brilliant yellow-brown is nitric acid. When strong nitric acid is rubbed over any of the light-colored woods it at once produces a very rich color; and after washing the wood with water, and drying it, and oiling it with linseed-oil, the surface presents such a handsome appearance that the process has been strongly recommended, and the recipe will be found in many works on angling and recommended for fishing-rods. Where mere appearance is all that is needed, the process is a very good one; but where, as in fishing-rods, it is desirable to retain the full strength and elasticity of the material, nitric acid should never be used. Any one can prove, by simple and easy experiments, that the strength of a rod is greatly reduced by the action of the acid.

Zinc.— By means of the following simple process, recommended by Bottger, a brilliant coating of zinc may be deposited on brass or copper: Boil a large excess of so-called zinc-dust, some time, with a concentrated solution of caustic soda, or potash, and place the copper or brass articles to be coated in the boiling liquid. By continuing the heating, after a few minutes a beautiful mirror-like film of zinc will form upon them by the deposition of the alkaline solution, in consequence of their electro-negative character in combination with the zinc. It is suggested that the process is applicable to the preparation of disks for dry-piles, and also for forming a layer of tombac, by heating a copper article thus coated, carefully, to about 248 to 284 deg. (best under olive-oil), when the [illegible] will unite with the copper support to form a gold-tinted tombac and the article need only be quickly cooled in water, or some other suitable liquid, as soon as the desired color is apparent.

Coloring Zinc.— A chemical process for covering zinc with colored coatings has lately been described by Dr. L. Stille. The articles of zinc are first brightened by scouring with quartz sand, moistened with dilute muriatic acid, putting them quickly in water, and then carefully wiping them dry with white blotting-paper. To insure success, however, it is necessary to employ zinc as free as possible from lead, and to have it as bright as a mirror. When these conditions are fulfilled, the metal may be coated with a variety of beautiful colors by immersion in a solution of alkaline tartrate of copper for a shorter or longer interval of time, depending on the color that is desired.

Black Color for Zinc.— Clean the surface carefully with fine sand or emery and sulphuric acid, and immerse for an instant in a solution of sulphate of nickel and ammonia,—4 parts in 40 parts of water acidulated with 1 part of sulphuric acid. Wash and dry. When burnished, this takes a fine bronze color.

INDEX